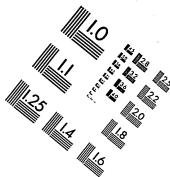
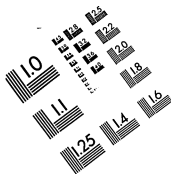




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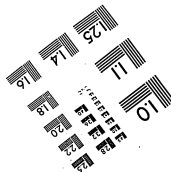
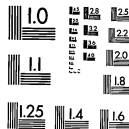
MS303-1980



Centimeter



Inches



Thomas A Edison Papers

A SELECTIVE MICROFILM EDITION

*PART II
(1879-1886)*

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1987

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18 June 1981

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START

40

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THOMAS A. EDISON PAPERS
A SELECTIVE MICROFILM EDITION
PART II
(1879-1886)

REEL 40

NOTEBOOK SERIES (NBK-18)

Menlo Park Notebooks, #186 - #215

Menlo Park Notebook #186 [N-80-12-24.1]

This notebook covers the period December 1880-February 1881. Most of the entries are by Francis Jehl. The notes, calculations, and drawings relate to special filament arrangements and to chemically treated and platinized carbons. There are also a few cross references by John Lawson to his experiments in Menlo Park Notebook #168. The label on the front cover is marked "Experimental Lamps (Special)," "1880," and "Francis Jehl." The book contains 284 numbered pages.

Blank pages not filmed: 274-277.

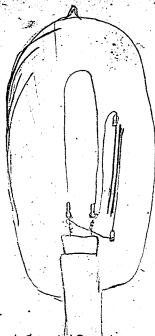
195
3890
130

LIBRARY OF THE
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

From Library
GENERAL ELECTRIC
44 Broad St. N.Y.

May 1, 1896



1
Ramp with Condens

E 177

~~18840~~
3500

R

48 C

177

~~3884~~
118

~~18840~~
3500

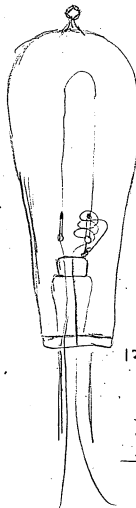
222340
111

178:13 0:1 111:

2.1139434
2.0453230
4.1592664
2.0718520

1.222
1.11
-11

2.0873844



E. 182

Q 18840
 5000
 223840

C 48119 .182
 31364
 121

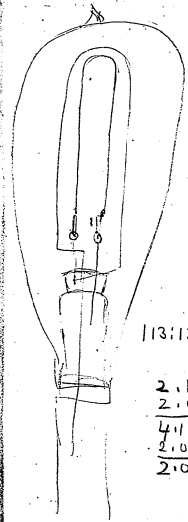
Y ohms

121:130:119

127.8
 119
 80ms

21139434
 210755470
 41894904
 210827854
 21067050

3

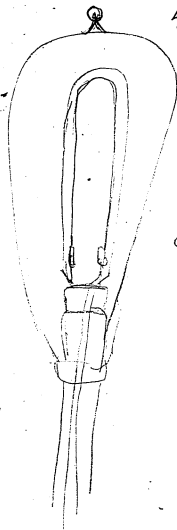


$$\begin{array}{r}
 6170 \\
 \underline{3340} \\
 113 \\
 18840 \\
 \underline{2200} \\
 21040 \\
 \underline{105} \\
 485
 \end{array}$$

15 ohms

$$\begin{array}{r}
 113:130:1105 \\
 \underline{120.5} \\
 15
 \end{array}$$

$$\begin{array}{r}
 2.1139434 \\
 \underline{2.0211593} \\
 4.1351327 \\
 \underline{2.0530764} \\
 2.0820543
 \end{array}$$



4

+7

E 195

$$\begin{array}{r} 5390 \\ 130 \\ \hline \end{array}$$

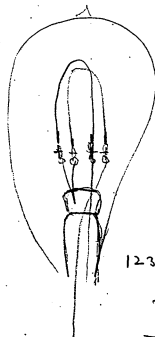
R 18843

3000

48

Very blue at the
clasp.

OK



E 184

$$\begin{array}{r} R \ 18840 \\ \underline{4500} \\ 22340 \end{array}$$

C 48

$$\begin{array}{r} 184 \\ \underline{2} \\ 368 \\ \underline{123} \end{array}$$

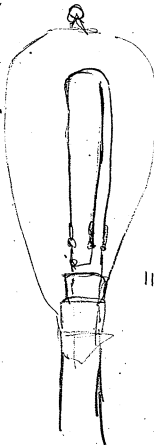
123:130:116

$$\begin{array}{r} 128 \\ \underline{16} \\ 12 \text{ plus} \end{array}$$

$$\begin{array}{r} 2.113.9434 \\ \underline{2.064.4580} \end{array}$$

$$\begin{array}{r} 4.1784014 \\ \underline{2.0899051} \end{array}$$

$$\begin{array}{r} 2.1084963 \end{array}$$



E 175

$$\begin{array}{r}
 R \ 1840 \\
 \underline{2700} \\
 221540 \\
 \text{C. } 107 \\
 48
 \end{array}$$

$$\begin{array}{r}
 175 \\
 \underline{3350} \\
 116
 \end{array}$$

116 1130:107

$$\begin{array}{r}
 2.1139434 \\
 \underline{2.0292838} \\
 4.1433272 \\
 \underline{2.0644580} \\
 2.0788692
 \end{array}$$

$$\begin{array}{r}
 119 \\
 \underline{2} \\
 12
 \end{array}$$

1/4/81 7

Treated with Petroleum
R 316.

E182

$$\begin{array}{r} 25127 \\ 3500 \\ \hline \end{array}$$

$$\begin{array}{r} 228627 \\ 143 \\ \hline 48e \end{array}$$

182

3(364)

1215

10 ohms

1211301143

211139484

2.1553360

4.2692794

2.0827854

2.1864940

1531

143

10

1/4/81

8

Treated with P. bromine
R. 435

E, 202

31400 R
42000

48C

202

2

31400

131

both high
 OK

react with ⁹Pelrotium
2 300

$$E.182 = 121 \text{ } 10 \text{ ohms}$$

$$R \begin{array}{r} 25127 \\ 1500 \\ \hline \end{array}$$

$$121:130:133$$

$$226627$$

$$C 48133$$

$$2.1139434$$

$$2.1238576$$

$$4.2377950$$

$$2.0827554$$

$$2.1550096$$

$$\begin{array}{r} 143 \\ 133 \\ \hline \end{array}$$

$$10$$

Platinized¹⁰ Loop

E 205

$$\begin{array}{r} Q \quad 31406 \\ \quad 2500 \\ \hline \end{array}$$

to high

$$\begin{array}{r} 333906 \\ \hline C \quad 48 \quad \cancel{112} \end{array}$$

this

169 ohm

2410

120

1365

130

169.

11

Treated with Petroleum 21
 R 035

E. 187

25727

270022727

C48

R

139

187
2
 3 374
 .124

Johns

124:130:139

2.1139484

2.1430148

4.2569582

2.0934217

2.11635365

146
139
 7

1/ ¹² Breastia with Carbolic ²³
2 ^{hairs} Acid. R. 190-256

E. 98

6227
5800 | R

24C.

13
Treated with Carbolic²⁵
acid
R 190-256 *

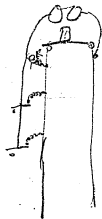
E101

R | 6277
| 8200

24 C

14 Caroline Reid. 1 27190 - 256

E. 94

6279 | R
5200C24 ~~10~~

11¹⁵ Carbolic Acid²⁹

E. 97

1194

6279 / R
6300

@ 48

16
Phosphorus. marked
106 V no 3

E 180

18840	31340	
<u>2000</u>	120 V	
	104 R	
220840		8 ohms
C48 104 R		

120:130:104

112
104
8

2.1139434

2.0170333

7.9208188

2.0517955

17
Phosphorus.

185	31370	
18840	126 V	
<u>6000</u>	124 R	
C48	224840	3 ohms
	124	

126:130:124

2.1139434

2.0934217

7.18996295

2.1059946

127

124

3

18

Chr. Carbon

Second test

128

121

$$\begin{array}{r} 128 \\ 12560 \\ 800 \\ \hline 13360 \\ C48 \end{array}$$

$$\begin{array}{r} 128 \\ 121 \\ \hline 2/249 \\ 124 \\ \hline 2/248 \\ 835 \end{array}$$

37 ohms

66 ohms

$$835130 : 6.6$$

$$\begin{array}{r} 103 \\ 66 \\ \hline 37 \end{array}$$

$$\begin{array}{r} 2.1129984 \\ 1.8195439 \\ 8.0809219 \\ \hline 2.0144092 \end{array}$$

19

Sodium

189 Blue at Lamp

$$\begin{array}{r} 18840 \\ 4500 \\ \hline \end{array}$$

$$\begin{array}{r} 189 \\ 3/378 \\ \hline 1260 \\ 116R \end{array}$$

C48

$$\begin{array}{r} 18840 \\ 4500 \\ \hline \end{array}$$

3 ohms

$$\begin{array}{r} 18840 \\ 4500 \\ \hline 2/23340 \\ 116 \end{array}$$

$$126 : 130 : 116$$

$$\begin{array}{r} 2.1139434 \\ 2.0644580 \\ 7.8996295 \\ \hline \end{array}$$

$$\begin{array}{r} 119 \\ 16 \\ \hline 3 \end{array}$$

$$2.0780309$$

20

Napthalene:

$$\begin{array}{r} 149.5 \\ 18840 \\ \hline 1000 \\ 219840 \\ \hline 99 \end{array}$$

48C

$$\begin{array}{r} 149 \\ 3 \overline{) 298} \\ 990 \\ 99R \end{array}$$

31 ohms

$$\begin{array}{r} 2.1139434 \\ 1.9956352 \\ \hline 8.0043648 \end{array}$$

$$2.1139434$$

$$\begin{array}{r} 130 \\ 99 \\ \hline 31 \end{array}$$

21

Benzoin

$$\begin{array}{r} 141 \\ 12520 \\ 5600 \\ \hline \end{array}$$

$$C48 \frac{218160}{90}$$

$$941130 : 90$$

$$\begin{array}{r} 141 \\ 3 \overline{) 282} \\ 940 \\ 90R \end{array}$$

$$30 \text{ ohms}$$

$$\begin{array}{r} 124 \\ 94 \\ \hline 30 \end{array}$$

$$2.1139434$$

$$1.9542425$$

$$8.0268721$$

$$2.0950580 = 124$$

$$\begin{array}{r} 1 \overline{) 99} \overline{) 99} \overline{) 1} \\ R \overline{) 99} \overline{) 1} \end{array}$$

22

Benzoin

$$\begin{array}{r} 133 \\ 12560 \\ 100 \\ \hline 12660 \\ \text{C} 48 \end{array}$$

$$\begin{array}{r} 3266 \\ 89.75 \\ 63. R \\ 28 \text{ ohms} \end{array}$$

89.7 : 130 : 63

$$\begin{array}{r} 2.1139434 \\ 1.7995405 \\ 8.0472076 \\ \hline 1.9604915 \end{array}$$

$$\begin{array}{r} 91.3 \\ 63 \\ \hline 2.8 \end{array}$$

$$\begin{array}{r} 3.9132839 \\ 1.9527924 \\ \hline 1.9604915 \end{array}$$

1.9604915

23

Sodium

$$\begin{array}{r} 185 \\ 18840 \\ 7000 \\ \hline 25840 \\ \text{C} 48 \end{array}$$

$$\begin{array}{r} 185 \\ 2 \\ \hline 3370 \\ 1235 \\ 129 R \end{array}$$

7 ohms

123 : 130 : 129

2.1139434

2.1105897

7.9100949

2.1346280

136

129

7

24

Napthalene

165	111.340
18840	112 R
3600	19 ohms
<hr/>	
C48	22440

111:120:112

2.1139434
2.0492180
7.9546760
<hr/>

2.1178374	131
	112
	<hr/>
	19

25

Extremely high vacuum
on pump.

175	2350
18840	1160
3600	112. Res
	13 ohms
<hr/>	

C48 22440

116:120:112

2.1139434
2.0492180
7.9355410
<hr/>

2.0987024	125
	112
	<hr/>
	13

Ex. high on pump

$$\begin{array}{r}
 171 - \\
 18840 \\
 2800 \\
 \hline
 221640 \\
 C48 \quad 108
 \end{array}
 \quad
 \begin{array}{r}
 3342 \\
 1145 \\
 108 \text{ Res} \\
 150 \text{ ohms}
 \end{array}$$

114 : 130 : 108 150 ohms.

$$\begin{array}{r}
 2.1139434 \\
 2.0334238 \\
 \hline
 4.1473672 \\
 2.0569049 \\
 \hline
 2.0904523 \\
 123 \\
 108 \\
 \hline
 15
 \end{array}$$

R poor vacuum Condenser

$$\begin{array}{r}
 195 \\
 \text{Reat} \\
 \hline
 3390
 \end{array}
 \quad
 \begin{array}{r}
 25127 \\
 2700 \\
 \hline
 27827 \\
 C48
 \end{array}$$

1305
139 Res

OK

2.1139434

28

Bamboo 8/17 lapew end

164

110.75

188.40

97. Res

700

19540 17 ohms

48

110:130:197:

2.1139434

2.9867717

7.9586073

2.0593224

5.1007151

2.0413927

3.0593224

114

97

17

Bamboo 10/17 29 5th hour very gradually

386

E192

25127

2500

27627

C48

120

129.65

138. R

OK.

Bamboo $\frac{8}{14}$ laps ends 267
P. 127

E 194

18840 130.90
 2100 104.0 hrs
20940

48

Bamboo $\frac{8}{14}$.035 thick
 .0625 on the ends .261.

E 183.5

124.85

R 18840

129 hrs

7100
 25940

50 hrs

48c

125 : 130 : 129

2.1139434

2.1105897

7.9030890

2.1276221

134
 29

5

Bamboo .008 inch
 taper from $\frac{19}{1000}$ to $\frac{15}{1000}$ in 1-9

E 182.

Q 18840.
 5000.

2 23840 1230

119

119R

C48.

6 ohms

123:120:119

2.1139434

~~158~~

2.0755470

7.9100949

2.0995853

125
19

⑦

Bamboo $\frac{10}{17}$ very gradually
 .375
 ~~~~~

E 185

R 18840  
7000

25840

124.85

129 ohms

5-ohms

C 48

125:130:129

2.1139434

2.1105897

7.9030890

2.1276221

134  
129  
5

34

Paper 9/17 781

New back Carbon

The Camp. N.G.

35

Baulbo .25 (hole 106-2.5 in)

ends. 261.

180 E. 121.5 U

130 R

$$\begin{array}{r} 18840 \\ 7200 \\ \hline \end{array}$$

26040

Johns

4.8 

122:130:130

2.1139.434

4.2278868

2.0863998

2.1414870 138

36

Bambo 8/17

5 hours regular 535

185

31370

1235

18840

8200

227040

135

48<sup>0</sup>

307 8ohms

123:135

123:130:135

143  
135  
08

2.1139434

2.1303338

7.910094.9

179  
35  
34

2.7543721

37

Bambo 8/17 <sup>1</sup> tapin on corner  
and clipped off end  
358

192

25127

4300  
29427192  
2384  
128

2ohms

48<sup>0</sup>

128:130:147.

2.1139434

2.1673173

7.8927890

2.1740497

149.  
147  
2

Regular Clamped by  
deposits Dec 24 1880.

$$\begin{array}{r} 145. \quad 3 \overline{) 290} \quad 20 \\ 97.5 \\ \hline 1250 \quad 66 \text{ ohms} \\ 700 \\ \hline 213260 \quad 23 \text{ ohms} \\ 66 \text{ ohms.} \\ 48 \end{array}$$

104.5  
50

$$97:130:66$$

$$\begin{array}{r} 6279 \\ 4500 \\ \hline 210779 \end{array} \quad \begin{array}{r} 2.1139434 \\ 1.8195439 \\ \hline 8.0132283 \end{array}$$

52.

$$\begin{array}{r} 1.9467156 \\ 3.9334973 \\ 1.9867717 \\ \hline 1.9467156 \end{array}$$

53 ohms

Edison Exhibit No. 7  
June 10 1885  
C. W. S.  
Notary Public

Regular Clamped by deposit

$$\begin{array}{r} 175 \\ 18840 \\ 2000 \\ \hline 220840 \\ 104 \end{array} \quad \begin{array}{r} 175 \\ 3 \overline{) 350} \\ 116 \quad 5 \\ 12 \text{ ohms} \end{array}$$

C46

$$116:130:104$$

$$\begin{array}{r} 2.1139434 \\ 2.0170333 \\ \hline 7.9355410 \end{array}$$

$$2.0665177$$

$$\begin{array}{r} 2.1139434 \\ 1.7242759 \\ 7.9829624 \\ \hline 1.8211860 \end{array}$$

Edison Exhibit No. 7  
June 10 1885  
C. W. S.  
Notary Public

40 in plate  
Ex. High or point

lot a burner with coils

No 15

1000

114.75 volts

18840

3500

2122340

111. ohms

14 ohms

48 C

11511301111 X+111

2.1139434

2.0458230

7.9393022

2.0985686

17.5

14

41  
No P heated with ashes  
97.50 in plate

116.10 volts

18840

2000

2120840

104 ohms

12 ohms.

48 C

2.1139434

2.0170333

7.9355410

2.0665177 = 116  
104

12



No A treated with ashes  
ag plated

114.75 volts

18840

~~40000~~

223640

118 ohms

150 ohms

48 C

$\frac{133}{118}$   
 1.12

2.1139432

2.0718820

7.9393022

2.1251274

No B treated with ashes 57  
ag plated

122.85 volts

18840

5200

224140

120 ohms

45 C

6 ohms

2.1139432

2.0798812

7.9100949

2.1032193

$\frac{126}{120}$   
 6



a treated with ashes  
Ag plated  $\text{W}^{\text{D}}$  e.

$$\begin{array}{r} 114.07 \text{ volts} \\ 18840 \\ \hline 2000 \\ \hline 221840 \\ 109 \text{ ohms} \end{array}$$

48<sup>o</sup>

$$\begin{array}{r} 124 \\ 9 \\ \hline 15 \end{array}$$

$$\begin{array}{r} 2.1139434 \\ 2.0374267 \\ 7.19430951 \\ \hline 2.0944652 \end{array}$$

treated with ashes  
Ag plated  $\text{W}^{\text{D}}$ .

$$\begin{array}{r} 114.75 \text{ volts} \\ 18840 \\ 3560 \\ \hline 222340 \\ 111. \text{ ohms} \\ 48^{\circ} \end{array}$$

$$\begin{array}{r} 2.1139434 \\ 2.0453230 \\ 7.9393022 \\ \hline 2.0985686 \end{array}$$

$\begin{array}{r} 125 \\ 111 \\ \hline 14 \end{array}$





a treated with ashes  
copper plated 495 volts  
no 8.

112.72 volts

18840  
1900  
220740 15 ohms  
103 ohms

48

2.1139434 118.  
2.10125372 3  
7.9469216 15  
2.0737022

a treated with ashes  
silver plated  
no 9

116.100 volts

18840.  
4500  
223340 14 ohms  
116 ohms

48

2.1139434 130.  
2.0644550 116  
79355410 14  
2.1139424

62<sup>a</sup>

No 2

Treated with ashes  
silver plated

120.15 volts

18840

4600

2/23440

48

117 ohms

9 ohms

21139434

20681859

719208188

2.1029481

126

9

a

Treated with ashes 63

1025 volts

No 3

ag. plated

120.15 volts

18840.

4600

2/23440

117 ohms

48

9 ohms

21139434

20681859

7



a treated with ashes  
101 volts Completed—

no 4

117.45 volts

18840

4500

12 ohms

---

 123340 116. ohms

48 C

|           |     |
|-----------|-----|
| 2.1139434 | 128 |
| 2.0644580 | 16  |
| 7.9318141 | 12  |

---

 2.1102155

a treated with ashes  
96.5 volts  
no 1 ~~Completed~~

111.34 volts—

18840.

2700

18 ohms.

---

~~5840~~ 21540

48 C 107 ohms

|            |     |
|------------|-----|
| 2.11139434 | 125 |
| 2.0293838  | 07  |
| 7.9546760  | 18  |

---

 2.0980032

treated with Acid ~~Q~~  
 104 Cy plated

No 17

123.52 volts

18840

4500

480

120.15

18840

4500

2123340

116 ohms

2.1139434

2.0644580

79208188

110992202

90 ohms

125

116

9

1021 treated with acid  
 No 20 Copper plated

118.12 volts

18840

3000

2121840

109

48

ohms

110 ohms

2.1139434

2.0374265

79281180

2.0794879

120.

109

11

73 Carbon treated Carbottreated

2190  $\frac{1}{2}$  size

no1

66.15 Volts

6279

6700

412979

64.0 ohms

24 C

100.5 treated with acids  
10 Cu plate~~107.82 volts~~~~18840.~~~~3200~~The carbon  
slipped out of  
these clamps

48 C

114.07 volts 15.0 ohms

18840 2.1139434

2600 2.0293838

221440 719430950

2.0874222

107 ohms

48

 $\frac{122}{15}$

treated with acids  
 101 V  
 no 14 Copper plate

~~103.95 volts~~

~~18840.  
 3200~~

48 C  
 114.07 volts 14 ohms

18840 - 2(21140  
 2300 105 ohms

48 C 2.1139434  
 2.0211893  
 119.  
14 7.9430950  
 2.0782227

Treated with acids 71  
 Ag. plated  
                    

123.52

18840.  
 4900

2123740  
 118 ohms

48 C 5 ohms

2.1139434  
 2.0718820

7.9065783

1.0924037 123  
18  
 25

J.E.

Treated with acid  
Cu plated

121.50 Volts

18840. 7 ohms  
4700

223540  
117 ohms  
48

2. 1139434  
2. 0681559  
7. 9186402

2.0957695

124  
17  
7

not  
#

Treated with acid 73  
Copper plated shanks

114.75 Volts

18840.  
3300

222140  
110 ohms

480. 14 ohms

2. 1139434  
2. 0413927

7. 939.30 22

210946383

124  
10  
14

74 104.5V Treated with acids

11. Ag. plated

122.85 volts

188.40

5200.

254040

120 ohms

6 ohms

480

2 11394.34

2 0791812

7 9100949

2.1032195

126

Treated with acids 75

No 6 Ag. plated  
104.5

119.475

188.40.

4700

24540

11 ohms

122 ohms

480

2 113943.4

2 0863998

7 9244520

2.1247952

133  
22  
11



Treated with acids.

No

Copper plated

116.77 volts

188.40  
35.00

12 ohms

222340

112 ohms

45C

2. 1139434

2. 0492180

7. 9318141

210959755124  
12  
1.2

10\* Treated with acid

107½ Ag plated

1#

120.15 volts

188.40  
57.002224540

10 ohms

122. ohms

45C,

2. 1139434

2. 0463598

7. 9208185

211211220132  
22  
10

78

No T

1008

Treated with acid

ag. plated,

118.12 volts

18840.

4200

110 ohms

2/23140

1150 ohms

48C

2. 1139434

2. 0606978

7. 9281170

2. 1027582

$$\begin{array}{r} 126 \\ 115 \\ \hline 11 \end{array}$$

No 8

Treated with Carbolic acid

190R

1/2 size

62.70 volts

6279

5000

2/11279

560 ohms

24C

~~2. 1139434~~

2.

7.

2016

1055

Treated with acid  
Cuplated

118.112 volts

18840 11 ohms  
 4700

423540 117 ohms

48C

2 1139434

2 0681859

7 9281170

2.1102463 12.8  
1.7  
 11

106

Treated with acid

1270

ag. plated

118.112 volts

18840 11 ohms  
 4700

223540  
 117 ohms  
 45 (

2 1139434

2 0681859

7

Treated with acids  
ag. plates.

10115  
90

116.10 colls

18840  
3000

421840

109 ohms

13 ohms

48 C

122  
149  
13

2, 1139434

2, 0374265

7, 9355410

2, 0869109

Camp. April 24  
12. 2591

93.15 volts

12500  
1400

13900

69 ohms

28 1-303. ✓

119,470

18840

3400

---

 22240

48c

111 ohms

2.0755470

2.0755470

1.6464037

7.9546760

---

 3.752237

5652. ft

719:130 :: 111

130

3330

111

---

 1143 0 (121

119

150

253

238

order

12

26 ✓

21

117,45 volts

18840

5300

---

 24340

121 ohms

48c

117.1130 :: 121

2.1139434

2.10827854

7.9318141

---

 2.1285429

13 ohms to be inserted

184

121

---

 13

8. *Camp Marsden*

263 -

121.50 volts -

18840 \*

5000

23840 = 119 ohms

48

76 to be maintained

2.1139434

2.0755476

7.9136402

2.1031306

126  
119  
7

8

order  
28 ✓

275

28

119.47 Volts

18840.

5000

24640 = 123 ohms

48 C

110 ohms

2.1139434

2.0899051

7.9244520

2.11283005

134  
23  
11

order  
29 ✓12.  
230

116.775

18840  
3100

11 ohms to be inserted

21940 - 109 ohms

48 e

#

120  
9

2 1139434

2 0344265

7 9318140

2 10802839

11

order 29 ✓

12 89  
246

116.105

18840  
3800

2/22640

113 - ohms

48

13 ohms inserted.

2.1139434

2.0530784

7 93.55410

2.1025628

126

113

13

25000 ✓

$$\begin{array}{r} 9 \\ 264 \end{array}$$

114.07 ✓

$$\begin{array}{r} 18840 \\ 1600 \\ \hline 2 \overline{) 20440} \quad \left( 102 \text{ sh.} \right. \\ \quad 48 \end{array}$$

140 sh. insert

$$\begin{array}{r} 2.1139434 \\ 2.0086002 \\ 79430951 \end{array}$$


---


$$2.10656387$$

$$\begin{array}{r} 116 \\ 02 \\ \hline 19 \end{array}$$

$$\begin{array}{r} \text{Order} \quad 7 \\ 26 \quad 208 \end{array} \quad \checkmark$$

110.02 ✓

$$\begin{array}{r} 18840 \\ 800 \\ \hline 2 \overline{) 19640} \quad (98. \\ \quad 480 \end{array}$$

170 sh. insert

2,1139434

1,9912261

---


$$7.9586073$$


---


$$2.10637768$$

$$\begin{array}{r} 115 \\ 98 \\ \hline 17 \end{array}$$



205 order  
26

18840  
1.200

2  $\overline{) 20040}$  100.

480

NO 28 Chloride Ammonium 5652 foot lbs - 93  
21 = Painted With Kerch Carbon - 117 1/2 volts 121 ohms  
8 Proc Sodium Res 119 - volts 121.50

94 Lamp <sup>order</sup>  $\frac{24}{259} \mid \frac{12}{259}$

118.12 v

10 ohms insert

$$\begin{array}{r} 18840 \\ 1300 \\ \hline \end{array}$$

$20140 = 100 \text{ ohms}$

48

2.1139434

2.           

7 9281170

2.0420604

25 <sup>order</sup>  $\frac{10}{251}$

95

114.75 v

2 18840  
94 ohms

48 @ 12 ohms insert

2.1139431

1.9731279

7.9393022

2.0263732

$$\begin{array}{r} 106 \\ 99 \\ \hline 12 \end{array}$$

58.

 $\frac{5}{299}$ 

125.555

$$\begin{array}{r} 18840 \\ 7200 \\ \hline \end{array}$$

26040 = 130 ohms

48e 4 ohms insert

2.1139434

2.1139434

7.8996295

2.1275163 134

22

 $\frac{12}{227}$ 

111.34 volts

$$\begin{array}{r} 18840 \\ .1000 \\ \hline \end{array}$$

19840 = 99 ohms

48e 17 ohms insert.

2.1139434

2.19956352

2.9546760

2.0644546

116

99

17

71<sup>v</sup>

114.750

 $\frac{11}{299}$ 

18840

3100

$$21940 = 109 \text{ ohms}$$

48e 14 ohms insert

2.113 94 34

2.037 42 65

7 939 30 22

2.090 67 21

$$\begin{array}{r} 123 \\ 109 \\ \hline \end{array}$$

14

74

$$\frac{6}{283}$$

122.170

18840

4500

$$23340 = 116 \text{ ohms}$$

7 ohms insert

2 11394 34

2 0644580

7 9136402

2.0920416

$$\begin{array}{r} 123 \\ 116 \\ \hline \end{array}$$

87

48e

53  $\frac{10}{250}$ 

115.435

$$\frac{18840}{2800} = 108 \text{ ohms}$$

48  $\text{ohms}$   
14,  $\text{insert}$ 

2.1139434

2.0334238

7.9393022

2.0866694

$$\frac{122}{108} = 14 \text{ ohms}$$

294

65

116.775

$$\frac{18840}{800} = 98 \text{ ohms}$$

48

10 ohms

2.1139434

2.9912261

8.9318141

$$\frac{2.0369836}{\frac{108}{48}} = 10$$

75  $\frac{10}{223}$

118612 volts

18840  
2400

21240 = 106 ohms

48 @ 10 ohms insert

2.1139434  $\frac{166}{10}$   
2.0253054  
7.9281170

2.0673658

50 order

9

103

249

120182 volts

18840  
4500

23340 = 116 ohms

48 @ 8 ohms insert

2.1139434

2.0644580

7.9172146

2.0956160

124  
116  
8

49

~~215~~

302

118.12 volts

$$\begin{array}{r} 18840. \\ 3000 \end{array}$$

21840 = 109 ohms

48 @ 11 ohms current

$$\begin{array}{r} 2, 1139434 \\ 2, 0374265 \\ 7, 9281170 \end{array}$$

$$\begin{array}{r} 210794869 \\ 120 \\ 09 \\ \hline 11 \end{array}$$

67

10  
250

121.50 volts

$$\begin{array}{r} 18840 \\ 4800 \end{array}$$

23640 = 118 ohms

48 @ 7 ohms current

$$\begin{array}{r} 2, 1139434 \\ 2, 0718820 \\ 7, 9136402 \end{array}$$

$$\begin{array}{r} 210994656 \\ 120 \\ 125 \\ \hline 7 \end{array}$$

$2449 \checkmark \quad 10/275$ 

118.8 volts

$$\begin{array}{r} 18840 \\ 4100 \\ \hline 22940 \end{array} \quad 114 \text{ ohms}$$

 $48e \quad 10 \text{ ohms insert}$ 

2.1139434

2.0569049

 $\underline{7.9244520}$ 

2.0953003

 $\begin{array}{r} 124 \\ 14 \\ \hline 10 \end{array}$ 
 $\frac{7}{213}$ 

70

118.80 volts

$$\begin{array}{r} 18840 \\ 2700 \\ \hline 21540 \end{array} = 107 \text{ ohms}$$

 $48e \quad 10 \text{ ohms insert}$ 

2.1139434

2.0293838

 $\underline{7.9281170}$ 

2.0714442

 $\begin{array}{r} 117 \\ \hline 10 \end{array}$





order 55  $\frac{9}{272}$ 

115.43006

$$\begin{array}{r} 18040 \\ 3500 \\ \hline 22340 \end{array} = 111 \text{ ohms}$$

48C

14 ohms insert

2.1139434  
2.10453220  
7.9393022

20.9855686

$$\begin{array}{r} 125 \\ 111 \\ \hline \end{array}$$

14

order 25  $\frac{10}{288}$ 

108.0005

$$\begin{array}{r} 12560 \\ 5000 \\ \hline \end{array}$$

$$17560 = 87 \text{ ohms}$$

48C

14 ohms insert

2.1139434

1.19395103

7.9665762

$$\begin{array}{r} 104 \\ 87 \\ \hline \end{array}$$

17

2.0200389

112 order 26 " 205"

111.340015

12560

7100

19660 = 98 ohms

48C 16 ohms insert.

2.1139434

1.9912261

7.9546760

2.10598755

114  
98  
16

order 69  $\frac{10}{242}$

113

This one with a very faint current  
was red at the top ( ) white  
the rest was black

116.100015

13 ohms insert

18840

3100

21940 = 109 ohms

48C

2.1139434

2.0374265

7.9355410

2.10869109

122  
109  
13

Ex 63 <sup>9</sup>  
291

124.830 volts

$$\begin{array}{r} 18840 \\ 7100 \end{array}$$

$$25940 = 129 \text{ ohms}$$

48  $\text{C}$  5 ohm insert

Chloride Barium

2.1139434

2.1105897

7.9030890

---

 2.1276221

$$\begin{array}{r} 134 \\ 129 \\ \hline 5 \end{array}$$
Ex 51 <sup>8</sup>/<sub>263</sub>

118.80 volts

$$\begin{array}{r} 18840 \\ 4500 \end{array}$$

$$23340 = 116 \text{ ohms}$$

10 ohm inserted

48

2.1139434

2.0644580

7.9244520

---

 2.1028534

$$\begin{array}{r} 126 \\ 16 \\ \hline 10 \end{array}$$

116 289 CEL<sub>3</sub>

101.25 volts

12560

5900

$$\frac{12560}{5900} = 92.0 \text{ ohms}$$

48°C 26 ohms insert

2.1139434

7.9637878

7.9956788

2.0744098

$\frac{118}{42}$

26

60 <sup>10</sup> 244

118.12 Volts

18840

3100

$$\frac{18840}{3100} = 109 \text{ ohms}$$

48°C 11 ohms insert

2.1139434

2.0374265

7.9281170

2.0794869

$\frac{128}{11}$

11

117

118 # 66 "304"

18840 11340 volts  
8700

22540 = 112 ohms

48 e 16 ohms inserted

2 1139434  
2 104921 80  
7 9469216

2 1100830  $\frac{128}{112}$   
0  
16

31 # 12

220

119

107.32 volts

18840  
700

19540 = 97. ohms

48 e 20 <sup>ohms</sup> inserted

2 1139434  
1 9867717  
7 9706162

2 0713313  $\frac{117}{97}$   
20

120

\*

Order 23

114.07 volts

18840

3000

21840 = 109 ohms

48°C

15 ohms inserted

2 1139434

2 0374265

7 9430951

2.0944650

124

15

#

3.1

#

12

121

248

122.85 ✓

18840

5000

23840 = 119 ohms

6 ohms inserted

2 1139434

2 0755470

7 9100949

48°C

2.10995853

125

19

6

order # 12  
27 239

114.75 volts

18840  
3500

22340 = 111 ohms

48c 14 ohms inserted

2.1139434

2.0453230

7.9393022

2.0985686  $\frac{125}{111}$   
14

Order 27 # 12  
232

113.40 volts

18840  
1800

20640 = 103 ohms

48 15 ohms inserted

2.1139434

2.0128372

7.9469216

2.0737022

$\frac{118}{103}$   
15



This lamp went up in phone  
room.

or # 30 14  
241

~~115~~ 115.800

18840  
4000

22840 = 114 ohms.

48

10 ohms wanted

2,1139434

2,0569049

7,9244020

2,0953003

124  
14  
10

$\frac{9}{255}$   $\frac{14}{239}$  or  $\frac{1}{103}$

111.340000

18840  
2300

21140 105 ohm

48 © 17 ohms inserted

211139434

2 0211893

7.9546760

2.0898087  $\frac{122}{17}$

16e 3789400

97.25

18840  
2300

8.7HP

22140 = 110 ohm

$\frac{14}{234}$  or 104

84.37 volts

37 ohms inserted

12560

1300

13860 = 69. Res

2.1139434

8388491

8.0387206

2.0285831 106

1.3

84

69

37

37

37

37

37

37

37

37

37

37

37

37

37

37

37

69

31

246

37

260

4330

14

 $\overline{104}$ 

259

 $\times 3.03$  Toll

12560

~~10000~~
~~20560~~

37 others wanted

13360 = 66 ohms

48C

$$\begin{array}{r} 21139424 \\ 8080.9219 \\ \hline 200144092 \end{array}$$
 $\frac{103}{37}$ 

69.36 U

$$\begin{array}{r} 12560 \\ 10000 \\ \hline \end{array}$$

13560 = 67.8

16C

 $\sqrt{69}$ 
 $\sqrt{67}$ 

10.6

 $\sqrt{69}$ 

$$\begin{array}{r} 621 \\ 414 \\ \hline 4761 \\ 444 \end{array}$$

$$\begin{array}{r} 19044 \\ 19044 \end{array}$$

$$\begin{array}{r} 67 \overline{) 209484} \quad (3126 \\ 201 \\ \hline 848 \\ 67 \\ \hline 178 \\ 173 \\ \hline 444 \end{array}$$

3126 / 33.000

$$\begin{array}{r} 3126 \\ 11 \\ \hline 3126 \\ 3126 \end{array}$$

$$\begin{array}{r} 3126 \\ 33000 \\ \hline 31260 \\ 174 \end{array}$$

12 or  
# 268 72.

108.00 volts

18840  
7400

26240 = 131 ohms

48 Candles 26 ohms measured

2 1139434  
2 1172713  
7 9665762

2.197809  $\frac{157}{101}$   
26

or 289  
68

120.15 volts

18840  
3500

22340 = 111 ohms

4.8 C 12 ohms measured

2.1139434  
2.0453230  
79208182

2.0800846  $\frac{123}{11}$   
12 ohms

$$\begin{array}{r} \text{or } 9 \\ 85 \overline{) 295} \end{array}$$

$$\begin{array}{r} 8 \text{ or } \\ 265 \quad 76 \end{array}$$

$$93.825$$

Blue at Clamp

$$\begin{array}{r} 12560 \\ 2500 \end{array}$$

$$15360 = 76 \text{ ohms}$$

$$48 \text{ C } 29 \text{ ohms used}$$

$$2.1139434$$

$$1.8808136$$

$$8.0268721$$

$$2.0216291$$

$$\begin{array}{r} 105 \\ 76 \\ \hline 29 \end{array}$$

# 12  
or 30 244

124.2 U

18840  
4000

22840 = 114 ohms

480 5 ohms insert

2,1139434

2 0569049

7.9065783

2.0774266

119  
17  
05

or 77 9  
245

127.57 U

18840  
4700

23540 = 117 ohms

480 2 ohms insert

2,1139434

2 0681859

7 8961963

2.10783256

119  
17  
2

# 16 <sup>11</sup>  
278

143,15

Blue around the Camp

7

8 79  
233

1141075

18840  
2300

$$\begin{array}{r} 21140 \\ 48 \end{array} = 105 \text{ obs.}$$

14 obs insert

2,113 943 4

2,021 1893

7,943 0951

8,078 2278

119.  
14

10 84

267

120.825

$$\begin{array}{r} 18840 \\ 5600 \\ \hline \end{array}$$

24440 = 122 ohms

45e 9 ohms insert

2.1139434

210.863598

19172145

---

 2.1175177

$$\begin{array}{r} 131 \\ 22 \\ \hline 09 \end{array}$$
12<sup>#</sup> order

22

245

11.6.75

18840

$$\begin{array}{r} 28000 \\ \hline \end{array}$$

21640 = 109 ohms

48e 11 ohms insert

2.1139434

210.863598

19172145

---

 2.0794869

$$\begin{array}{r} 120 \\ 9 \\ \hline 11 \end{array}$$



or 80 270

117.45 U

18840  
2100

20940 = 103 lbs

48 C 110 lbs meat

2.1139434

2.0128372

7.9318141

2.0585947

154  
11

or 85  $\frac{9}{295}$

127.57.5

18840  
7400

26240 = 131 lbs

+ 8

30 lbs meat

127; 130; 131

2.1139434

2.1172713

7.8961963

2.1274110

134  
31  
3

p137 Platinized Loops

$$\begin{array}{r} 141.75 \text{ U} \\ 25127 \\ \hline 7000 \end{array}$$

$$\underline{48 \text{ } \odot}$$

$$\text{at } 130 \text{ U} = 25 \text{ } \odot$$

$$\begin{array}{r} 25127 \\ \hline 200 \\ 2 \quad (25927) \\ 129. \end{array}$$

$$\begin{array}{r} 25027 \\ \hline 126 \end{array}$$

$$\begin{array}{r} 15840 \\ 5800 \\ \hline 24540 = 122 \text{ } \odot \end{array}$$

January  
 order no 65 mg naphthalene  
 crystals dissolved in gasoline  
 swirled around.  
 ((8) (no 2.)) (18 334) (1095)  
28

130 volts

$$\begin{array}{r} 1840 \\ 9000 \end{array} \text{ Res} \\ \hline 200$$

48 C

OK

Platinized loops 1/5/81  
 D 137 loop soaked in Pt sol.<sup>145</sup>  
 96½

112.72 volts

$$\begin{array}{r} 1840 \\ 1600 \end{array} \text{ R} \\ \hline 20440 = 102 \text{ Res} \\ 48$$

113: 130 :: 102 15 ohms

$$\begin{array}{r} 2.1139434 \\ 2.0086002 \\ \hline 7.9469276 \end{array}$$

2.0694652

$$\begin{array}{r} 117 \\ 102 \\ \hline 15 \end{array}$$

(this heating quick) (14-)  
 2.135 (261)  
 100 1/2 V 4

115.8 volts

18840  
 5600

24440 = 122 ohms

48 Candles

110 ohms

119:130 :: 122

2.1139434

2.0863598

7.1244520

2.1247552

133  
 122  
 11

(125/81) (16/20 106.)



128.25 volts

18840  
 6000

24840 = 124 ohms

48 C

20 ohms

128:130 :: 124

2.1139434

2.10934217

7.18927890

2.1071541

126  
 24

$\frac{1}{209}$  1/25/81  
(no 16)

124183 volts

1840 } Res  
3100

21940 = 104 ohms

4 ohms

2.1139434

2.0170833

7.9030890

2.0340657

108

order no 13

22 high

64.13 U

40 ohms

$\frac{6279}{1600}$  Res.

7879 = 39.1

641130:39

$\frac{79}{39}$   
40

2.1139434

1.8910646

8.1938190

1.08988270

\* Large fall tube on pump, heated quick  
2 hours

37 Candles at 130 volts

N.Y.

( Large fall tube on pump  
13 heated quick  
232 2 hours. )

116.10 volts

$$\begin{array}{r} 18840 \\ 3200 \end{array} \bigg| R. 1$$

$$22040 = 110 \text{ ohms}$$

116:130 :: 110 13 ohms

$$\begin{array}{r} 2.4139434 \\ 2.0413927 \\ \hline 7.9355410 \\ \hline 2.10908771 \end{array}$$

$$\begin{array}{r} 123 \\ 10 \\ \hline 13 \end{array}$$

Heated quick  $\frac{15}{263}$   
2 hrs

119.47 volts

10 ohms

$\frac{18840}{3200} | R$

$\frac{23040}{48} = 110 \text{ ohms}$

119 : 130 : : 110

2,113,943.4

2,041,392.7

7,924,452.0

2,079,788.1

$\frac{120}{10}$

order no 15  $\frac{18}{283}$   
970

118.12 volts

$\frac{18840}{2400} | R$   
 $\frac{21240}{48} = 106 \text{ ohms}$   
48  $\ell$  10 ohms

118 : 130 : : 106

2,113,943.4

2,025,308.9

7,928,117.0

2,067,366.3

$\frac{11.6}{0.6}$   
10

order no 14 no 21  
 HT in C: 1025

12 17

$$\begin{array}{r} 120.15 \text{ volts} \\ 18540 \\ \hline 4400 \end{array} \bigg| R$$

$$23240 = 116 \text{ ohms}$$

$$48 \text{ C} \quad 9 \text{ ohms}$$

$$120 : 130 : 116$$

$$\begin{array}{r} 2.1139434 \\ 2.0644580 \\ \hline 7.9208188 \\ 2.0992202 \end{array}$$

$$\begin{array}{r} 125 \\ 10 \\ \hline 9 \end{array}$$

$$\begin{array}{r} \text{nick heated} \\ 2 \text{ hrs } 40 \\ \hline 155 \\ 250 \end{array}$$

$$\begin{array}{r} 122.85 \text{ volts} \\ 4900 \\ \hline 18540 \end{array} R$$

$$23740 = 118 \text{ ohms}$$

$$48 \text{ C} \quad 6 \text{ ohms}$$

$$123 : 130 : 118$$

$$2.1139434$$

$$2.0718820$$

$$7.9100949$$

$$2.10959203$$

$$\begin{array}{r} 128 \\ 10 \\ \hline 6 \end{array}$$



Healed quick  
1015 2.56  
(14)

122.85 volts

$$\begin{array}{r} 5500 \\ 16840 \end{array} \bigg| R$$


---


$$24340 = 121 \text{ ohms}$$

48  $\odot$  6 ohms

123:130:121

2.1139434  
2.0827854  
7.9100949

---

2.1068237

127  
21  
6

Healed quick 2.56 <sup>157</sup>

15  
294 103 1/2 19

~~122.85 volts~~

$$\begin{array}{r} 16840 \\ 7600 \end{array} \bigg\}$$


---


$$26440 = 132 \text{ ohms}$$

48  $\odot$  7 ohms

123:130:132

2.1139434 139  
2.1205739 32  
7.9100949 7

---

2.1446122

healed quick  $\frac{16}{248}$   
 2. 38 hrs.  
 102  $\frac{1}{2}$  5 6

120.82 mls

8 ohms

$\frac{18840}{3500}$  } Res 121:130::113  
~~22~~  
 22640 = 113.0 hrs

48 C

121:130::113  
~~130:121::113~~

~~2.1139.24~~

~~2.053.11.4~~

V

3.7  
 quick Reet  $\frac{16}{248}$  116 v 30

130.2 voltammals of 30 C

2.1139434  
 2.0530784  
 7.9172146

2.0842364

~~2.1139434~~  
~~2.0530784~~  
~~7.9172146~~

2.0842364

$\frac{121}{13}$   
 8

Heated quick

$$\begin{array}{r} 3.34 \\ \underline{5} \\ 355 \\ 101\frac{1}{2} \quad 17 \end{array}$$

124.83 volts

$$\begin{array}{r} 18840 \\ 4800 \\ \hline 23640 \end{array} \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{Re. } 118 \text{ ohms}$$

$$23640 = 118 \text{ ohms}$$

48  $\rho$  4 ohms

125:130:118

$$\begin{array}{r} 2.1139434 \\ 2.0718820 \\ \hline 7.9630890 \end{array} \quad \begin{array}{r} 122 \\ 18 \\ \hline 4 \end{array}$$

2.0889144

heated quick

$$\begin{array}{r} 3.34 \\ \underline{5} \\ 349 \\ 99\frac{1}{2} \quad 13 \end{array}$$

122.17 volts

121.50 volts 7 ohms

$$\begin{array}{r} 18840 \\ 4500 \\ \hline 23340 \end{array} \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{Res. } = \frac{18840}{7} = 116 \text{ ohms}$$

122:130:116

$$\begin{array}{r} 2.1139434 \\ 2.0644580 \\ \hline 7.9136402 \end{array} \quad \begin{array}{r} 123 \\ 16 \\ \hline 7 \end{array}$$

2.0920416

heated quick 99  
 hrs 3.34  $\frac{11}{365}$  1

---

103  $\frac{1}{2}$  18  $\frac{13}{257}$   
 quick heated 2.40  
 128.920  
 123 R  
 2 ohms went

quick Laid 3.19

13 268 108

128.925

127 R.

2 ohms used

quick Laid

319 16 235 780  
6

122.170

107 Res

7 ohms used

quicksilver 16  
319 289  
1105 21

128.25 5.  
118 ohms R.  
2 ohms wvnt

quicksilver  
16 257 100 1/2 2

122.17 volts  
119 R  
8 ohms wvnt

rapid quick  
 78 1/2 hrs 3.34 11  
 19 310

121.50.0

113 02

8 ohms insert.

quick head in  
 2.43.  $\frac{13}{241}$  119

33 Cables at 1300

W. J.

heated quartz  
98.3 2.38

120.15 v

113 R

10 ohms/cm

heated quartz  
2.56 \* 16 261

122.85 v

118 ohms R

7 ohms/cm



Healed quick

$\frac{15}{226}$  238  $\frac{101}{2}$

121.50 v

110 R

T. ohms insert

quick healed

3.T. 96 v 24

121.5 v

104 R

T ohms insert

174

quick heated

2.38 15 99V

224

121.5 v

112 R

8 ohms

11

heated quick

365

hrs 3.34

120.82 volts

117 ohms R.

9 ~~#~~ ohms

175

99

1

176

Heated quick

13

223

2.56

102  $\frac{1}{2}$  7

122.85 ✓

10.7. R.

6 others west.

177

Heated quick

2.38 9.4  $\frac{1}{2}$  1015

225

118.80 ✓

109 R.

10 others west.

January 29 1888

Lot of 21 a order 46

285

1025

15

129.60 v

6600

18840

R

OK

48 C

Caulis of Potash

Order 46 R 308.

107 1/2 26

130.27 v

8600

18840 R

OK

48 C

order 46 R 283

Pumps with Canolic Polaris  
 in it 27 order 46  
 28.3 1055.

129.60 V

$$\begin{array}{r} 7600 \\ 18840 \end{array} \bigg| R$$

$$26440 = 1$$

R 45 C

OK

Order 46 R 283

105 V

14

128.25 ✓

$$\begin{array}{r} 18840 \\ 8250 \end{array} \bigg| R$$

27040 135 ohms  
 2 ohms out

2,113 9434

2,113 03338

7.892 7890

---

 2,137 0762

137

182

Order 46 R 334

108 1/2.5 3

131.635

9900  
18840

| R

48 e

183

Order 46 R 289

108 V

9

131.635

8400  
18840

| R

OK

order 46 R 312

• 110 V

6

134.32 V

$$\begin{array}{r|l} 25127 & R \\ 3900 & \end{array}$$

order 46

104 V

R 325

1

129.60 V

$$\begin{array}{r|l} 25127 & R \\ 3900 & \end{array}$$

OK.

• 28027 = 140 R

Order 46 10.8V  
R 299 10

131.63 V

$$\begin{array}{r} 1700 \\ 25127 \end{array} | R$$

$$26827 = 134 \text{ ohms}$$

2.1139434  
2.11271048

97V 19  
20 R 11615-

cu deposite

120.15V

$$\begin{array}{r} 4400 \\ 18840 \end{array} | R$$

$$23240 = 116 \text{ ohms}$$

2.1139434  
2.0644580  
7.9208188

2.0992202

125  
10  
9



1015 20 1/27/81  
cu deposit, 20#

120.15 ✓

$$\begin{array}{r} 3700 \\ 18840 \end{array} | R$$

22540 - 112 ohms

48 C 9 ohms insert

2.113 94 34

2.0049 21.80

$$\begin{array}{r} 7.9208188 \\ \hline \end{array}$$

210839.802

$$\begin{array}{r} 121 \\ 12 \\ \hline 99 \end{array}$$
1065  
2.7

20

cu deposit

126.22 ✓

$$\begin{array}{r} 5900 \\ 18840 \end{array} | R$$

24740 = 123 ohms

48 C

4 ohms.

10 1/2 V  
15 an deposit

119.47 V

1700  
8840 | R

20540 = 102 ohms

2.1139434  
2.0086002

719244520

2.0469956

9 ohms insert

94 1/2 V

21

109.35 Volts

12560  
6100 | R

18660 = 93 ohms

17 ohms insert

Order 138

No 16 (8)

98  $\frac{1}{2}$ No 16<sup>(a)</sup>108  $\frac{1}{2}$  v130 Volts130 Ohms0 Coil48 Candles

Σ or 158.

$$785 \text{ def.} = 124.83 \text{ v}$$

18840  
4100

22940

114 ohms

48

125 : 130 : 114

201139434

20569049

79030890

210739373

118  
5

e-158

$$175 \text{ def.} = 118.12 \text{ v}$$

18840  
4600

2(23440)

117 ohms

\* 12 ohms

118 : 130 : 117

2.1139434

2,068.1859

719281170

201102463

129  
17  
12

a  
 or 185: 127.57 volts  
 189 def

$$\begin{array}{r} 18840 \\ 4600 \\ \hline 2 \overline{) 23440} \end{array} \quad \begin{array}{l} * \\ 2 \text{ ohms} \end{array}$$

117 ohms

128:130:117

$$\begin{array}{r} 2.1139434 \\ 2.0681859 \\ 7.8927890 \\ \hline 2.0749183 \end{array}$$

118

16(b). 98.5 or 108.

175 def 118.125

$$\begin{array}{r} 18840 \\ 800 \\ \hline 2 \overline{) 19640} \end{array} \quad \begin{array}{l} 98 \text{ ohms} * \\ 10 \text{ ohms} \end{array}$$

118:130:98

$$\begin{array}{r} 2.1139434 \\ 1.9912261 \\ 7.9281170 \\ \hline 2.0332865 \end{array}$$

108  
 98  
 10

158.  
 ♂.

180 Def 1 121.55

18840  
 3700. | Def. Res

2(24540  
 122 ohms \* 9 ohms

2.1139434.  
 2.0863598  
 7.9136402  
 2.1139434 130

No B. 158

119.3

179 Def = 120.825

18840  
 2900

2(21740

108. R

⊗

\* 8 ohms used

17

121113011108

2.1139434  
 2.0834238  
 7.9172146

210645818

116  
 08  
 8

Order 132 R 220  
Feb 2 1881

118.12 U

$$\begin{array}{r} 18840 \\ \underline{400} \\ 19240 \end{array} \bigg| R$$

= 96 ohms

48 C 9 ohms inserted

118:130:196

$$\begin{array}{r} 2.1139434 \\ 1.9822712 \\ \underline{7.9281170} \\ 2.0243316 \end{array} \begin{array}{r} 105 \\ 96 \\ 9 \end{array}$$

Feb 2, 1881.  
Order 132 R 210  
15

$$\begin{array}{r} 18840 \\ \underline{1400} \\ 20240 \end{array} \bigg| R$$

101 ohms

48 C

15 ohms inserted

112.72 U

$$\begin{array}{r} 2.1139434 \\ 2.0043214 \\ \underline{7.9469216} \end{array}$$

210651864

116  
101

Feb. 2, 1881.  
Order 132 R 220  
20

117.455

18840  
3400 | R

22240 111 olms.

48 p 12 olms incant.

2.1139434

2.0453230

7.9310141

123  
11

2.0910805

12

Feb. 2, 1881.  
Order 132 R 245  
24 (B)

~~12115~~ 5

112105 5 16 olms incant

18840  
1600 | R

2.0440 = 102 olms

48

2.1139434

2.0086502

7.9507810

2.0743246

118  
02

16



Feb. 2, 1881.  
Order 132, R 270  
12

121.50 ✓

188.40

3600

R

7 ohms inserted

22440 = 112 ohms

480

119  
12

2.1139434

2.0492180

7.9136402

2.0778016

Feb. 2, 1881.  
Order 132, R 248  
25

118.12 ✓

188.40

2700

R

21540 = 107 ohms

480

11 ohms inserted

2.1139434

2.0293838

7.9281170

2.0714442

Feb. 2, 1881.  
Order 132, R 255  
17

121.505 7 ohms insert

$$\begin{array}{r} 18840 \\ 2500 \overline{)R} \\ 21640 = 108 \text{ ohms} \end{array}$$

48 C. 115

2.1139437  
2.0334238  
7.9136402

2.0610074

Feb. 3, 1881.  
Order 132, R 230  
19

116.775

$$\begin{array}{r} 18840 \\ 2500 \overline{)R} \\ 21340 = 106 \text{ ohms} \end{array}$$

48 C. 12 ohms insert

2.1139434 115  
2.0253059 106  
7.9318141 12

2.0710634

Feb. 2, 1881.  
Order 132 H. ee

120.15 ✓

$\begin{array}{r} 18840 \\ 4200 \end{array} | R$

23040 = 115 ohms

48 C

9 ohms insert.

2.1139434 124  
2.0606978 15  
7.9208188 9

210.954600

Feb. 2, 1881.  
Order 132, R 208.  
102 C - 20

113.40 ✓

$\begin{array}{r} 18840 \\ 1100 \end{array} | R$

19940 = 99 ohms

48 C

15 ohms insert

2.1139434 164  
1.9956352 69  
7.9469215 25  
2.0565001

Feb. 2, 1881.  
Order 132, (No tag)  
105 1/2 & 24 (A)

~~120.155~~

~~115~~

1 116.775

18840 | R 11 ohms insert  
2100  
20940 = 104 ohms

648

2 1139454  
21017.0833  
719318149

210627908

115  
04  
19

Feb. 2, 1881.  
Order 132, R270  
100 1/2 - 4

114.755

18840

4800

R

20640 = 118 ohms

48

15 ohms  
insert

2. 1139434

210715820

719393022

21257276

133  
18  
15

Feb. 2, 1881.  
Order 132, R20  
16

~~112.72 v~~

112.72 v

15 ohms out

$$\begin{array}{r} 18840 \\ 1800 \overline{)R} \\ \hline 20340 = 101 \text{ ohms} \end{array}$$

48 c

$$\begin{array}{r} 2.1139434 \\ 2.0043214 \\ \hline 7.9469216 \\ \hline 2.0651864 \end{array}$$

116

Feb. 2, 1881.  
Order 158-U

121.50 v

$$\begin{array}{r} 18840 \\ 6800 \overline{)R} \\ \hline 25640 = 128 \text{ ohms} \end{array}$$

48 c 8 ohms in/out

$$\begin{array}{r} 2.1139434 \\ 2.1072100 \\ \hline 7.9136402 \end{array}$$

$$\begin{array}{r} 2.1347936 \\ \hline 13.6 \\ \hline 8 \end{array}$$

Feb. 2, 1881.  
Order 138-R 300  
26

121.505

18840  
6800  

---

25640 = 128 ohm

48 C 8 ohms insert

Feb. 2, 1881.  
Order 158-R 158  
9

118.125

18840  
~~4000~~  

---

22840 = 114 ohm

48 C 11 ohms insert

2 113.9434  
2 1056 90 4.9  
7.928 11 70  

---

2.0987653

125  
14  
11

Feb. 2, 1881.  
Order 158 - ~~WT~~

116.10 ✓

18840  
4000

22840 = 1140 hrs

48  $\text{C}$  130 hrs ment

2 113 9.4 3 4  
2 056 9.0 4 9  
7 93 554 10

2.1063893

12.7  
13

Feb. 2, 1881.  
Order - 158  $\text{C}$  \*

121.50 ✓

18840  
7000 | R

25840 = 1290 hrs

48  $\text{C}$  80 hrs ment

2 1113 9.4 3 4  
2 110 58 9 7  
7 913 64 0 2

2.138.1733

137  
29  
8

Feb. 2, 1881.  
Order 158 Y

121.505

18840  
7300 | R

26140 = 130 ohms

48 C 8 ohms

122.130 : 130 : 138

2 1139434  
2 1139434  
7 9136402

2 1415270

Feb. 2, 1881.  
Order Z 158

Twice ~~examined~~  
~~examined~~

124.83 V

18840  
6600 | R

25440 = 127 ohms

48 C 5 ohms

125 : 130 : 127

127  
910  
260  
130

125/16510/1

2 1139434

2 1038037

79030890

21208361

132  
127  
5



Feb. 2, 1881.

X  
Order 158

121.50 V

$$\begin{array}{r} 18840 \\ 2700 \end{array} \bigg| R \quad \text{7 ohms in vert}$$

$$21540 = 107 \text{ ohms } 0.$$

$$122 : 130 : 107 :: 107 : \cancel{107} X$$

$$\begin{array}{r} 130 \\ 107 \\ \hline 910 \\ 130 \\ \hline 122 \overline{) 13910} \overline{) 114} \\ 122 \\ \hline 171 \\ 122 \\ \hline 490 \\ 488 \\ \hline 2 \end{array}$$

Feb. 2, 1881.  
Marked  
H. J. W.

101.25 V

$$\begin{array}{r} 12560 \\ 1400 \end{array} \bigg| R$$

$$13660 = 68 \text{ ohms}$$

48 C

101

Feb. 2, 1881.  
 Tag - 1/27/81 - #21  
 Pk. 1. p. 15 (20)  
 J. W. L.

~~E. M. T. 1300 - OK.~~

126.9 V

188.40  
 6100

2 ohms 2

24940 | 124. ohms ohms

127  $\frac{124}{130}$

127  $\frac{372}{124}$   
 $\frac{127}{127}$

127  $\frac{116.120}{127}$

342  
 254  
 880  
 762  
 118

126  
 124  
 2

Feb. 2, 1881.  
 Order 117 - 101 1/2 V.

124.83 V

18840  
 4600

23440 = 117 ohms

4 ohms insert

48e

$\frac{1130}{351}$   
 $\frac{117}{125}$   
 $\frac{125}{15210}$   
 $\frac{125}{125}$   
 $\frac{271}{250}$   
 $\frac{210}{125}$   
 $\frac{85}{85}$

Feb. 2<sup>nd</sup> 1881.

Order 117-101 V.

~~two half 2 loops in the~~  
cap 119.47 ✓

18840 11 ohms in set

5700

24540 = 122 ohms

48 C

$$\begin{array}{r}
 122 \\
 130 \\
 \hline
 3660 \\
 122 \\
 \hline
 119 \overline{) 15860} \overline{) 133} \\
 119 \\
 \hline
 396 \\
 357 \\
 \hline
 390 \\
 357 \\
 \hline
 33
 \end{array}$$

Feb. 2, 1881.

Oct #9-99 1/2 V

12  
one with a Condenser

120.82 ✓

18840 | R 8 ohms in set  
3500

22340 = 111 ohms

48 C

$$\begin{array}{r}
 111 \\
 130 \\
 \hline
 3330 \\
 111 \\
 \hline
 121 \overline{) 14430} \overline{) 119} \\
 121 \\
 \hline
 233 \\
 121 \\
 \hline
 1120 \\
 1089 \\
 \hline
 31
 \end{array}$$

$$\begin{array}{r}
 5762 \overline{) 33000} \quad (6+ \\
 \underline{33872} \\
 519
 \end{array}$$

$$\begin{array}{r}
 127 \\
 \underline{127} \\
 889 \\
 254 \\
 \underline{127}
 \end{array}$$

$$\begin{array}{r}
 16129 \\
 \underline{4403}
 \end{array}$$

$$\begin{array}{r}
 48387 \\
 64516 \\
 \underline{64516} = 2
 \end{array}$$

$$124 \overline{) 7145147} \quad (5762$$

$$\begin{array}{r}
 945 \\
 \underline{945}
 \end{array}$$

$$\begin{array}{r}
 945 \\
 \underline{868}
 \end{array}$$

$$\begin{array}{r}
 7712 \\
 \underline{620}
 \end{array}$$

$$\begin{array}{r}
 51
 \end{array}$$

$$\begin{array}{r}
 771 \\
 \underline{744} \\
 270
 \end{array}$$

Feb. 3, 1881.  
Order 44 - R 275  
104 1/2 U - 5

130.27 V



1544 U  
5200

24040 = 120 R.

OK

48C

Feb. 3, 1881.  
Order 44 - R 275  
112 U - H

130.27 V

25127  
5200

30327 = 151 plus

24 eat this.

Feb. 3, 1881.

Order 44-R 230

95V-1

116.775

$$\begin{array}{r} 18840 \\ 300 \end{array}$$

$$\frac{19140}{10} = 95 \text{ ohms}$$

48C

20 ohms int.

$$\begin{array}{r} 105 \\ 95 \\ 10 \end{array}$$

2.1139484

1.9777236

7.9318141

2.0234811

Feb. 3, 1881.

Order 44-R 245

95V-22

114.75V

$$\begin{array}{r} 18840 \\ 600 \end{array} | R$$

$$\frac{19440}{10} = 97 \text{ ohms}$$

48C

12 ohm insert

1139484

9867717

9393022

0400173

$$\begin{array}{r} 109 \\ 97 \\ 12 \end{array}$$

Feb. 3, 1881.  
Order 44-R285  
107 1/2 V-10

130. V.

25127  
1500

26627 = 133 ohms

36 C

Feb. 3, 1881.  
Order 44-R250  
97 V-17

118.12 V

18840  
2000 R

20840 = 104 ohms

48 C 100 ohms unit

113943.4  
0170333  
9281170

0590937

114  
4  
10

Feb. 3, 1881.  
Order 44 - R 300  
113 1/2 U - 3A

130.5

25127  
~~3000~~

R

28127

140. R

38C

Feb. 3, 1881.  
Order 44 - R 280  
106 U - 27

130.5

18840

~~5200~~

R

24040 = 120 ohms

48C

OK



Feb. 3, 1881.  
Order 44-R 280  
111 1/2 U-6

$$\begin{array}{r} 130. \checkmark \\ 25127 \\ \hline 1300 \\ \hline 26427 = 132 R \end{array}$$

36 C

Feb. 3, 1881.  
Order 44-R 295  
112 U-13 B

$$\begin{array}{r} 130 \checkmark \\ 25127 \\ \hline 3200 \\ \hline 28327 = 141 \text{ ohms} \end{array}$$

36 C

Feb. 3, 1881.  
Order 44-R 270  
108 U-25

130 ✓

25127 R 1250 hrs

48 C

OK

Feb. 3, 1881.  
Order 44-R 285  
109 U-13

130 ✓

1884 U  
6000 R  
25640 = 128 R.

48 C

OK

Feb. 3, 1881.  
Order 44-R 290  
99 V-11

124.83 V

$$\begin{array}{r} 18840 \\ 3500 \\ \hline 22340 \end{array} R = 111 \text{ ohms}$$

48 C

OK

Feb. 3, 1881.  
Order 44-R 300  
104 1/2 V-25

130.5

$$\begin{array}{r} 18840 \\ 7100 \\ \hline 25940 \end{array} R = 129 R$$

48 C

OK

Feb. 3, 1881.  
Order 44-R 310  
113 V-23

130 V

18840  
9700R

28540 = 142 ohms

48C

OK

Feb. 3, 1881.  
Order 105-R 337  
108 V-15

130 V

18840  
7300R

26140 = 130 ohms

48C

OK

Feb. 3, 1881.  
Order 105-R 278  
111 1/2 U-13

130 V

$$\begin{array}{r} 1840 \\ 8300 \\ \hline 27140 \end{array} R$$

$27140 = 135 \text{ ohms}$

34 C

Feb. 3, 1881.  
Order 120-R 312  
113 1/2 U-24

130 V

$$\begin{array}{r} 25127 \\ 4000 \\ \hline 29127 \end{array} = 145 \text{ ohms}$$

~~110~~  
32 meters

Feb. 3, 1881.  
 Order 120-R 480  
 Lot 8 - High 22

---

130 V  
 very high R.

Feb. 3, 1881  
 Order 131-R 405  
 115 V - 17

---

130 V

$\frac{25127}{6100} R$

$31627 = 158 \text{ ohms}$

33C

Feb. 3, 1881.  
 Order 131 - R 375.  
 118 V - 15

---

130 ✓

25127  
 8200 R

---

33327 = 166 ohms

30 C

Feb. 3, 1881.  
 Order 137 - R 345  
 18

---

130 ✓

25127  
 5700 R

---

30827 = 154 ohms

34 C

Feb. 3, 1881.  
Order 137-R340  
30

found it busted.

Feb. 3, 1881.  
Order 137-R310  
7

130 v

18840  
3000 R

22840 = 111 ohms

30 c



Feb. 3, 1881.  
Order 143-R 410  
122 U-7

130 V

25127  
7500

$$\frac{25127}{7500} R$$

$$3262.7 = 163 \text{ ohms}$$

22 C

Feb. 3, 1881.  
Order 143-R 420  
1

130 V

25127  
6000

$$\frac{25127}{6000} R$$

$$319.27 = 159 \text{ ohms}$$

48 C

OK

Feb. 3, 1881.  
Order 143 (A)

130 V

25127  
7300 R

32427 = 162 ohms

26 C

Feb. 3, 1881.  
Order 143 (B)

~~130 V~~

~~25127~~

to high Res

Feb. 3, 1881.

Order 131 - R 185

123 U - 23

bushel when got it.

Feb. 3, 1881

Order 131 - R 380

116 1/2 U - 1

130 V

25127 V

9500

R

34627 = 173 ohms

48 C

Feb. 3, 1881.  
Order 125-R 360  
118 U-16

130 V

$$\begin{array}{r} 25127 \\ 6500 \text{ R} \\ \hline 31627 = 158 \text{ ohms} \end{array}$$

81 C

Feb. 3, 1881.  
Order 125-R 355  
119 U-30

130 V

$$\begin{array}{r} 25127 \\ 6200 \text{ R} \\ \hline 21327 \\ 22 \text{ C} \end{array} = 106 \text{ ohms}$$

Feb. 3, 1881.

Order 125-R 330

•  $117\frac{1}{2}$  U-7 $130\sqrt{}$ 

$$\begin{array}{r} 25127 \\ 3300 \end{array} R$$
 $28427 = 142 \text{ ohms}$ 

29C

Feb. 3, 1881.

Order 127-R 410

 $121\frac{1}{2}$  U-6 $130\sqrt{}$ 

$$\begin{array}{r} 25127 \\ 6800 \end{array} R$$
 $33427 = 167 \text{ ohms}$ 

C 23

Feb. 3, 1881.

Order 126-R 290  
118 1/2 V-3

130 V

25127

4300 R

29427 = 147 ohms

24e

Feb. 3, 1881.

Order 126-R 290  
103 1/2 V-22~~130 V~~~~25127~~~~4300~~

121.50 V

Feb. 3, 1881.  
Order 126 - R 256  
99 1/2 U-2

119.47V

25127 R 12 ohms  
1500 went

261.27 = 130 ohms

48 C

142  
330  
12

1139434  
1139434  
9244520  
1523388

Feb. 3, 1881.  
Order 138 - R 290  
13

120.525

18840  
3500 R 8 ohms went  
22340 = 111 ohms

48

119  
8

1139434  
0453230  
9172145  
20764810

Feb. 3, 1881.  
Order 138 - R 315  
23

130 ✓

18840  
5900  
24740 = 1230 hrs

48°

OK

Feb. 3, 1881.  
Order 129 - High 16

found it busted



Feb. 3, 1881.  
Order 129 - High 19

No vacuum. Went up.

Feb. 3, 1881.  
Order 107 - P 429  
121 U - H

130 ✓

25127

9800

---

34927 = 174 ohms

16 Candles.

Feb. 3, 1881.  
Order 115-R 365  
120 V-17

130 V

$$\begin{array}{r} 25127 \\ 9800 \overline{) } \\ \hline 34927 \end{array} R = 174 \text{ ohms}$$

19C

Feb. 3, 1881.  
Order 115-R 340  
116 V-3

130 V

$$\begin{array}{r} 25127 \\ 7600 \overline{) } \\ \hline 32727 \end{array} R = 163 \text{ ohms}$$

25C

Feb. 3, 1881.  
Order 115-R 334  
112 1/2 U-9

130 V

25127 R  
7300  
32427 = 162 ohms

26 C.

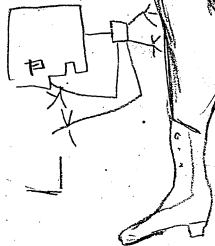
Feb. 3, 1881.  
Order 115-R 350  
122 1/2 U-16

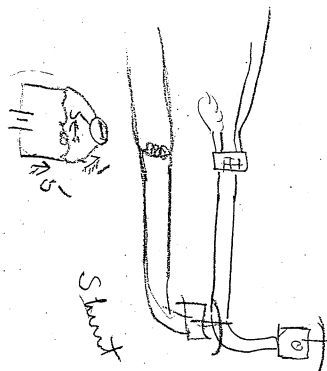
130 V

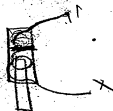
31406  
~~5000~~ R  
36406 =  
182 ohms

16.0 C









$$\begin{aligned} \epsilon &= \frac{e}{R} \\ CR &= \frac{e}{R} \\ R &= \frac{e}{C} \end{aligned}$$

1 W  
3C

120

115

115

575

115

1725

5175

6900

6900

120

764

720

441

360

81

15

15

$$200) 1000 (.00$$

$$200) 1000.005$$

$$\frac{11}{10} \quad 5 \quad 6 \quad 15$$

$$\frac{1}{10000} R \quad 10000$$

$$104.130 \quad 53$$

2

$$2.1139484$$

$$1.7242759$$

$$7.9829667$$

$$1.8210840$$

**Menlo Park Notebook #187 [N-81-01-00]**

This is one of six notebooks that were probably begun on January 10, 1881. It contains notes by Charles Batchelor on gas lighting, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184). There are additional entries by Batchelor, along with entries by Edison and occasionally by other members of the laboratory staff. Included are notes, calculations, and drawings relating to meters; and drawings of dynamos, voltage regulators, and other electrical devices. The book contains 284 numbered pages.

Blank pages not filmed: 78-81, 116-119, 140-143, 146-241, 252-259, 262-271.

Missing page numbers: 281-282.



1.265

16  
5  
80  
16  
6  
16  
4  
64  
16  
80

65  
4  
260

1000  
260  
4) 940 | 185  
34  
32  
20

Cost of Laying Gas Mains  
P364 No 32  
Treat. on Coal Gas

Yearly table of Gas burning  
hours Gas Engines, Locomotives, etc.  
 $\frac{8}{4} = \frac{1}{3}$  way through

Get first case where gas  
was sold to consumers?

Get Steam city Gas as a  
manufacturing industry

~~What was~~ Money made in  
Railroads

English \$140.000  
French. \$101.877  
United States 400000



$$\begin{array}{r} 12 \\ 2 \\ \hline 24 \end{array} \quad 24$$

Relating to Gas  
under heading

of Gas  
gas plant  
Coal Gas

Annual production of Coal 1874

260,000,000, tons

Enc. Brit Vol VI page 73

up to date in Great Britain  
there is consumed for illuminating  
purposes Tons 1010-000-000  
Newbiggin's Page 25

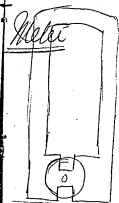
Paris 1878.

7484,000,000. Cub. ft gas

Public lamps 45,000,

Gas engines in Paris consume

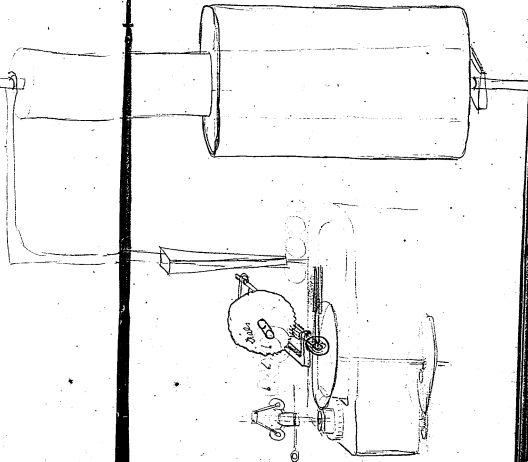
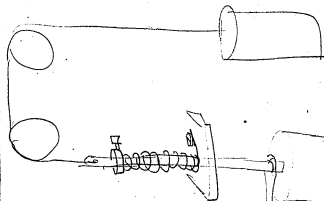
55,300,000 c.F. per year



Jan

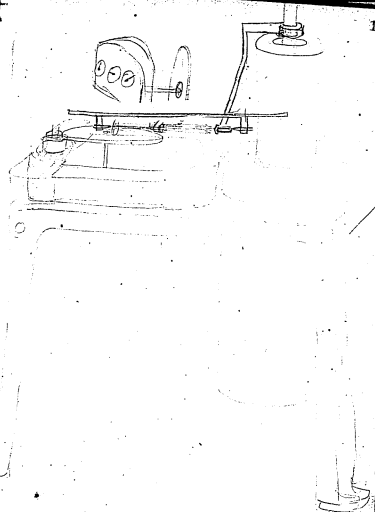
1881





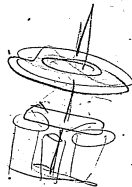
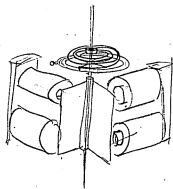
14

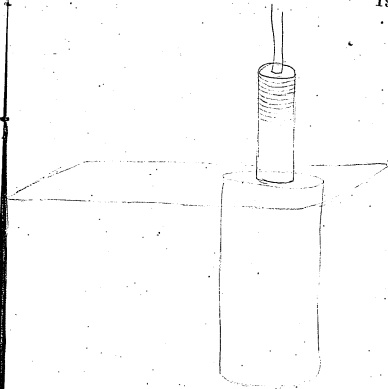
15



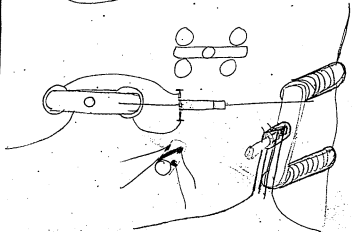
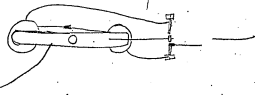
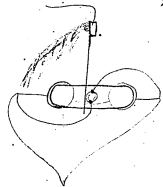
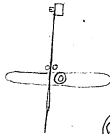
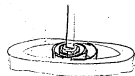
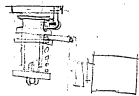
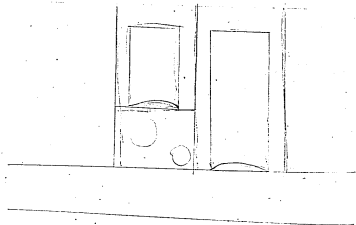


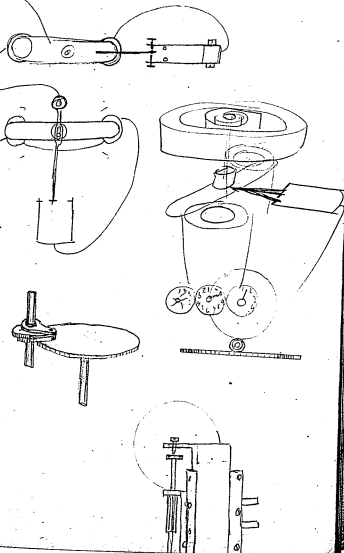
Len Tag

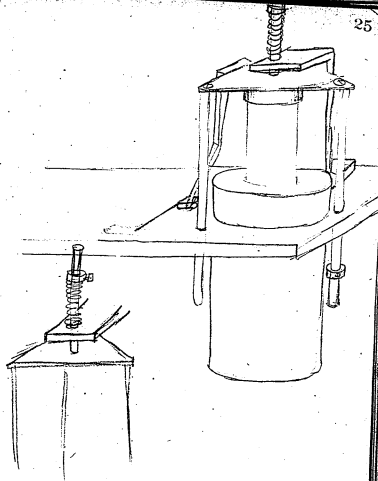


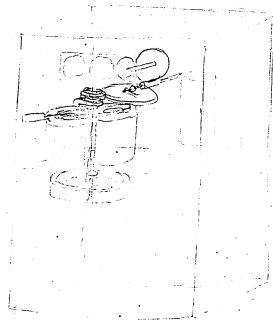


2 1/2  
2 1/4



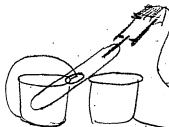
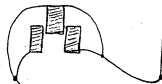
Meter



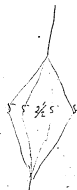


31

Meter Jan 24<sup>th</sup> 1881  
 Crofta Chalm



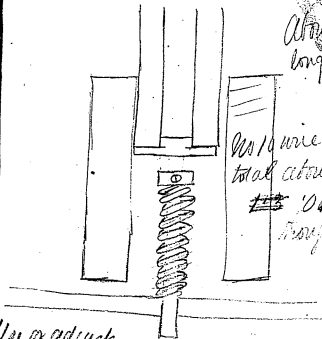
50

6  
1  
5

2 1/2

1/4

1/4



About 8"  
long

Use 14 wire  
total about 1/4"  
~~1/8"~~ 0.05 inches  
thru all

Use or adjust  
~~1/8"~~ a spring for each different  
number of lights



$$\begin{array}{r} 5.304 \\ 768 \overline{) 12168} \end{array}$$

$$\frac{4.8}{1.1}$$

$$\frac{160}{160} \bigg/ \frac{1000}{160}$$

$$\begin{array}{r} 4.4 \\ 6.88 \overline{) 10.68} \\ \underline{5.34} \end{array}$$

$$\begin{array}{r} 2 \\ 316 \overline{) 192} \\ \underline{628} \end{array}$$

40 threads

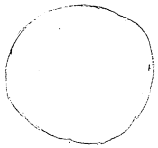
$$\begin{array}{r} 1.40 \\ 3.46 \overline{) 4.86} \\ \underline{1.46} \\ 4.296 \end{array}$$

large.

2  
 of 2 inches and 3 layers '03½ shms  
 inside less '03½ shms.

'033  
 .033

$$\frac{1896}{6400} \bigg/ \frac{6400}{7120} \quad 1:03\frac{1}{2}$$



$$\begin{array}{r} 415 \\ 36 \\ 24 \\ \hline 600 \end{array}$$

100

45

$$\begin{array}{r} 434000 \\ 410000 \\ \hline 1868000 \\ 420000 \\ \hline \end{array} \quad 0.21$$

$$\begin{array}{r} 89 \\ 59 \\ 30 \\ \hline 29 \\ 3175 \\ \hline 3144 \\ 1216 \end{array}$$

$$\begin{array}{r} 154 \\ 3164 \\ 1570 \\ \hline 5174 \end{array}$$

$$\begin{array}{r} 205 \\ 384 \\ 100 \\ 250 \\ \hline 7850 \end{array}$$

(157)

$$\begin{array}{r} 1 \\ 1 \\ \hline 2 \end{array} \quad 22$$

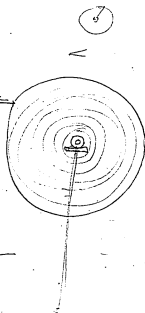
$$\begin{array}{r} 656 \\ 1115 \\ 8280 \\ 656 \\ \hline 75460 \end{array}$$

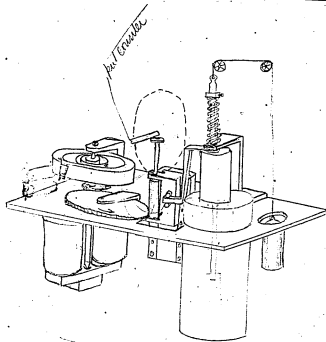
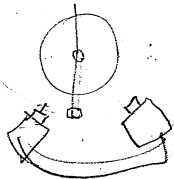
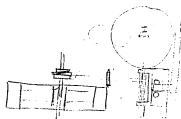
$$\begin{array}{r} 454 \\ 375 \\ 5770 \\ 52718 \\ 22612 \\ 2820760 \\ \hline 565 \end{array}$$

After  
each camp  
must put  
an increase.  
of register.

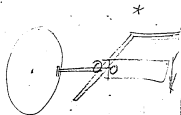
Start with a circle of  
30 and end.

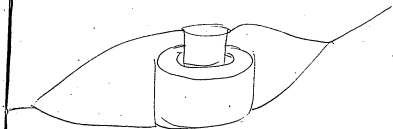
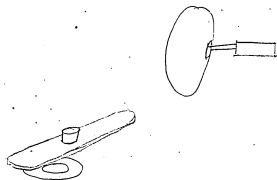
3 20  
3 14  
6 20  
3 14  
1 2 5 6 6  
1 2 5 6 6  
3 14



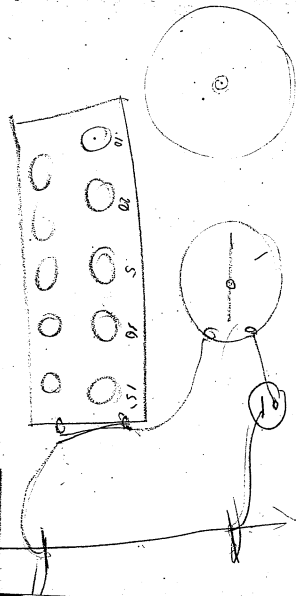


Chlo.  
Spoke  
Break face

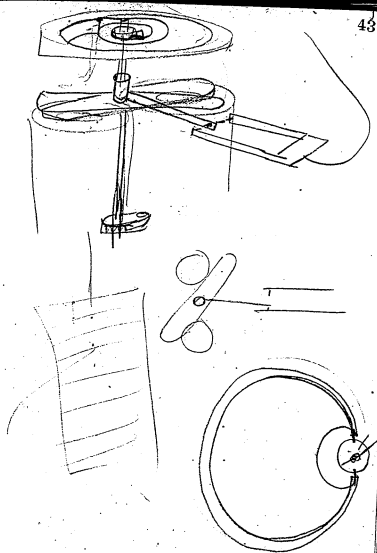


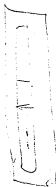


42

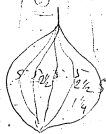
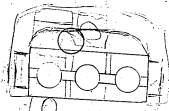
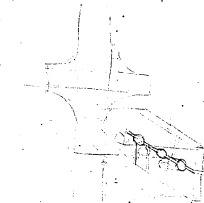


43



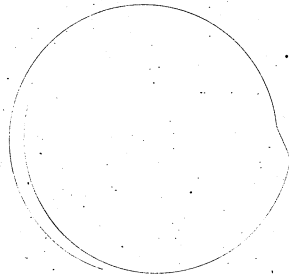
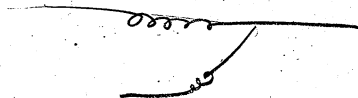
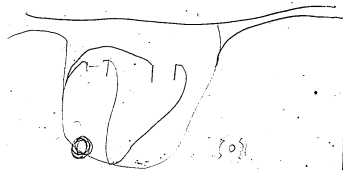


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2 5

7/1

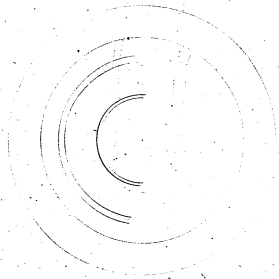




3

K200

100



~~Result of the~~

~~Result of the~~ in Com

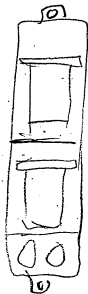
164 1/2 inches No 21 B.W.G. Laminar tubes  
there to the ohm

The coil 5 in diam 15 in diam, one foot  
long 8 turns to the inch 1440 inches @

1440 inches give 10 ohms

96 turns

16 3/4 in wide 13 1/4


 $6\frac{1}{8}$ 

16

 $6\frac{1}{4}$   
 $7\frac{3}{4}$ 


---

 14

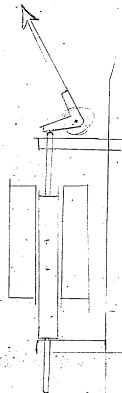
 $5\frac{7}{8}$ 
 $7$   


---

 $12\frac{3}{8}$ 

1.6

|||



$$\begin{array}{r}
 2\frac{5}{8} \\
 \frac{3}{8} \\
 \frac{3}{4} \\
 \frac{1}{8} \\
 2\frac{5}{8} \div 1\frac{1}{2} \\
 \frac{8}{6} \\
 2\frac{3}{4}
 \end{array}$$

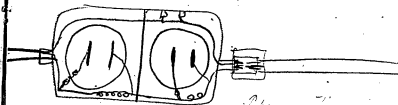


$$\begin{array}{r}
 8 \\
 24 \\
 2 \overline{) 48} \quad 18. \\
 \underline{36} \\
 18
 \end{array}$$



July 28 1881

Tal

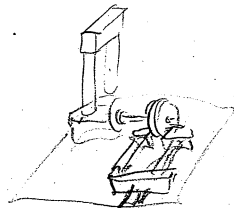
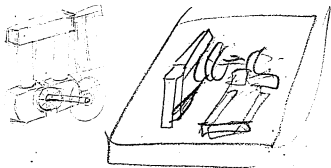


Life motion

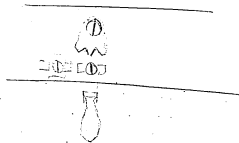
No 26 50 feet .01894 diam

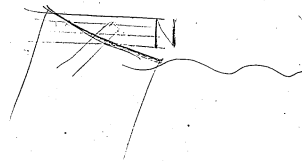
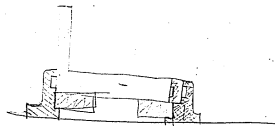
March 4, 1881

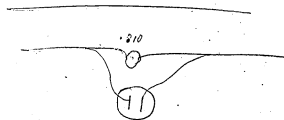
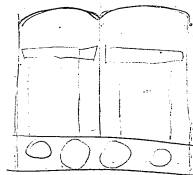
J. A. B.

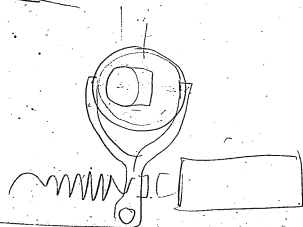
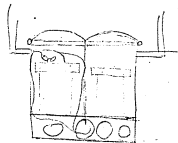
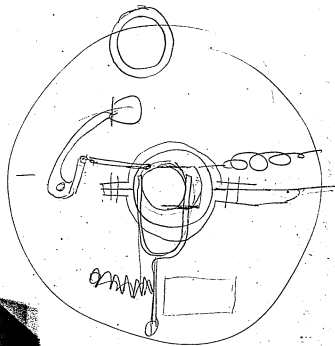


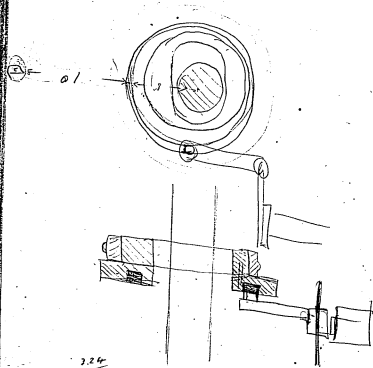








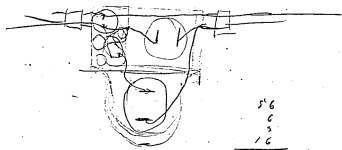




$$\frac{2.24}{100}$$

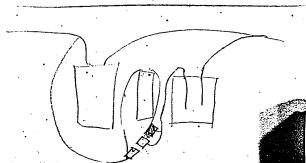
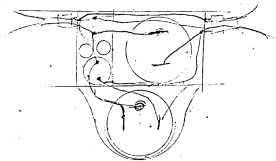
$$\begin{array}{r} 28 \\ 2 \\ \hline 56 \\ 12 \\ \hline 68 \end{array}$$

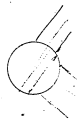
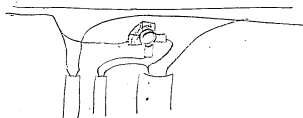
6

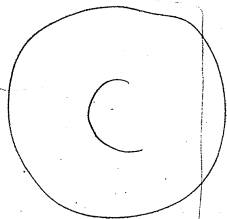
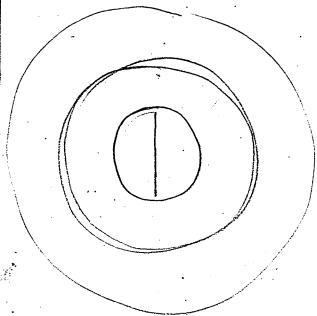


$$\begin{array}{r} 56 \\ 6 \\ 3 \\ 16 \\ \hline 81 \end{array}$$

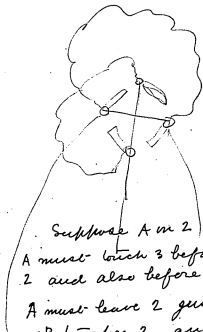
$$\begin{array}{r} 28 \\ 3 \\ \hline 84 \end{array}$$



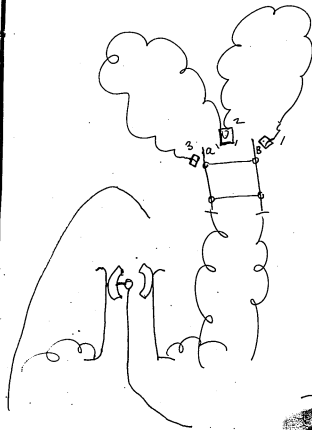


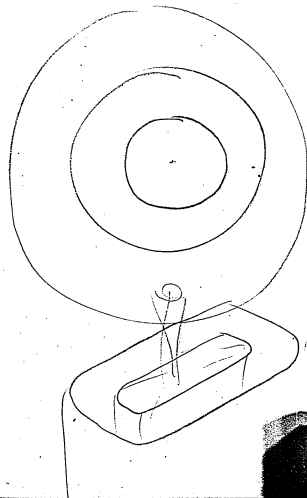
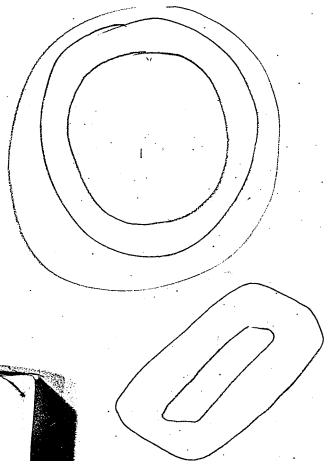


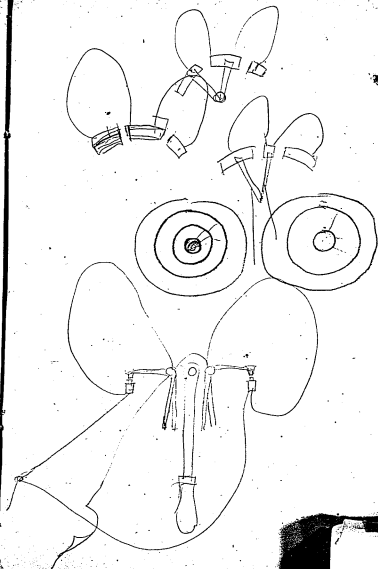
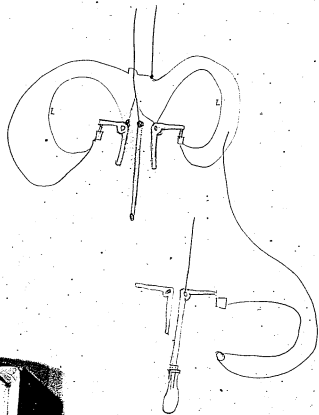


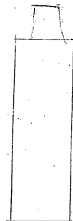
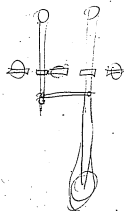
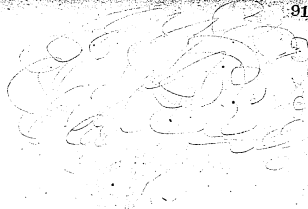
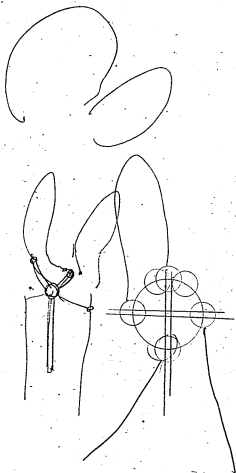


Suppose A on 2 - B on 1  
 A must touch 3 before leaving  
 2 and also before B leaves 1  
 A must leave 2 just before  
 • B touches 2 and B must  
 touch 1 and 2 at once.









$$\begin{array}{r}
 75/6 \\
 4 \\
 \hline
 25 \quad 2012 \\
 30 \quad 24
 \end{array}$$

$$\begin{array}{r} 22 \overline{) 16} \\ \underline{44} \\ 16 \end{array}$$

$$5 \frac{3}{4}$$

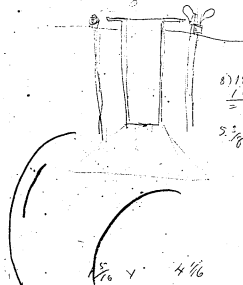
$$\begin{array}{r} 7 \\ 1 \frac{1}{4} \\ \hline 8 \frac{1}{4} \end{array}$$

$$\frac{7}{16} \times 1 \frac{1}{4}$$

$$1 \frac{1}{4}$$

$$\frac{7}{8}$$

$$1 \frac{3}{16} \quad 4 \frac{5}{8}$$



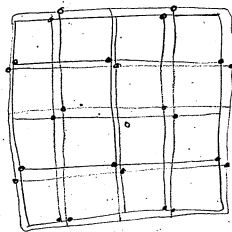
$$\begin{array}{r} 8 \overline{) 18 \frac{3}{2}} \quad (2) \\ \underline{16} \\ 2 \end{array}$$

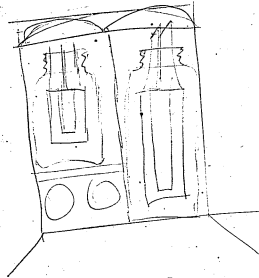
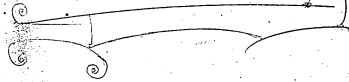
$$5 \frac{3}{8}$$

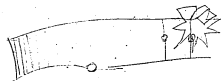
$$8$$

$$\frac{5}{16} \times 4 \frac{1}{6}$$

$$2 \frac{8}{16} \times 4 \frac{3}{16} = 11 \frac{1}{4}$$







$$\begin{array}{r} 15 \\ 15 \\ \hline 60 \end{array}$$

$$\begin{array}{r} 15 \\ 3 \\ \hline 45 \end{array}$$

500 x

376

3 1/2

$$\begin{array}{r} 33 \\ \times 105 \\ \hline 165 \\ 3300 \\ \hline 3465 \end{array}$$

400

$$\begin{array}{r} 1035 \\ 150 \\ \hline 1790 \\ 35 \\ \hline 5250 \end{array}$$

.. 64

$$\begin{array}{r} .04. \\ 150 \\ \hline 600 \end{array}$$

$$\frac{1011}{16}$$

10 1/2  
10 7/8

1671

$$\begin{array}{r} 1000 \\ 500 \\ \hline 50 \overline{) 470} \quad (29) \\ \underline{450} \\ 20 \end{array}$$



10 11/16

.880

10070

5'250

10,700

5'250

$$\begin{array}{r}
 50 \overline{) 5450} \quad (10 \\
 \underline{50} \\
 450 \\
 \underline{450} \\
 0
 \end{array}$$

0'650

$$\begin{array}{r}
 109 \\
 \underline{50} \\
 5450
 \end{array}$$

$$\begin{array}{r}
 10700 \\
 \underline{5250} \\
 50 \overline{) 5450} \quad (109 \\
 \underline{50} \\
 450 \\
 \underline{450} \\
 0
 \end{array}$$

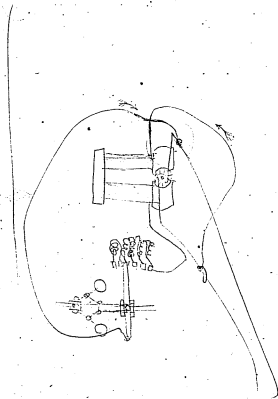
250

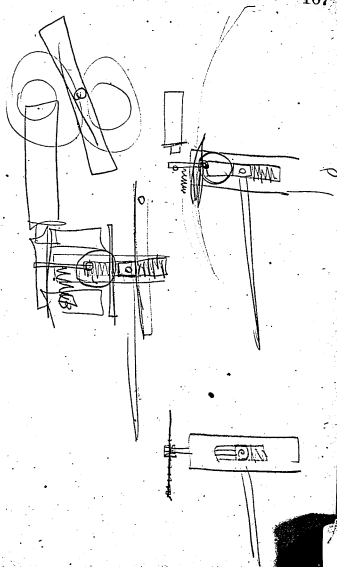
$$\begin{array}{r}
 10253 \\
 \underline{150} \\
 12650 \\
 \underline{0253} \\
 034950
 \end{array}$$

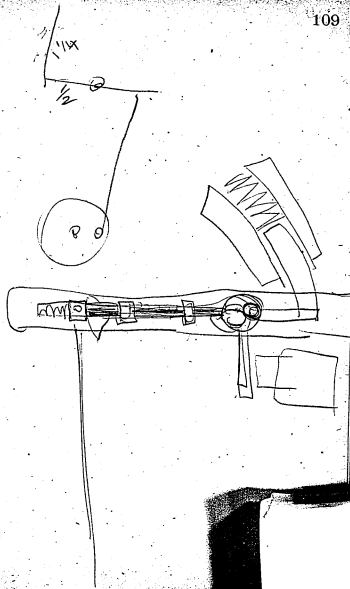
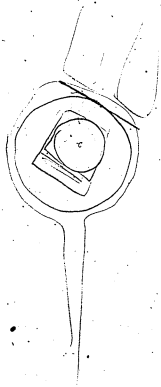
f 5

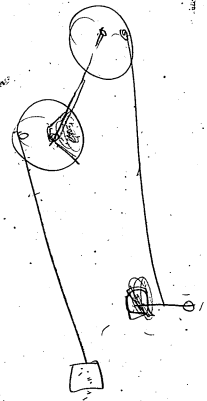
37

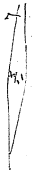
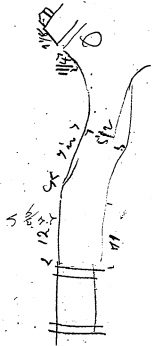
$\leftarrow 2\frac{5}{8} \rightarrow$  in side of bar  
 $\leftarrow 3\frac{1}{4} \rightarrow$  1/2 of bar  
 $\leftarrow 3\frac{1}{2} \rightarrow$  3/4 of bar  
 $\leftarrow 3\frac{3}{4} \rightarrow$  rods  
 $\leftarrow 4 \rightarrow$  inside part  
 $\leftarrow 4\frac{1}{4} \rightarrow$  outside =  
 $\leftarrow 4\frac{3}{4} \rightarrow$  3/4 of bar  
 $\leftarrow 5\frac{1}{4} \rightarrow$





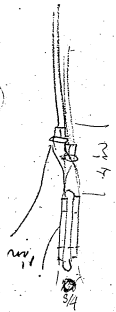




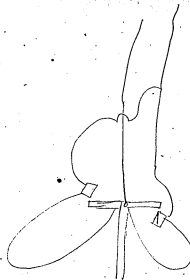


Connecting nut

Spring 1/4 square steel  
1/2 in spiral



Base of fly wheel 6 in

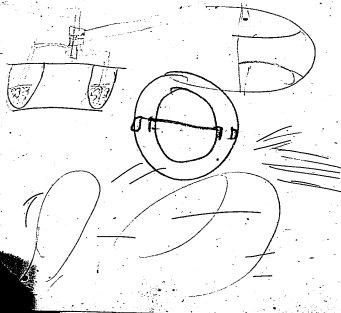




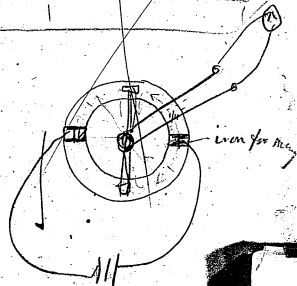
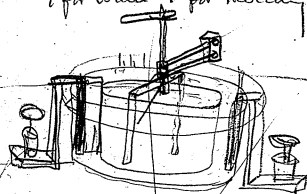
diameter

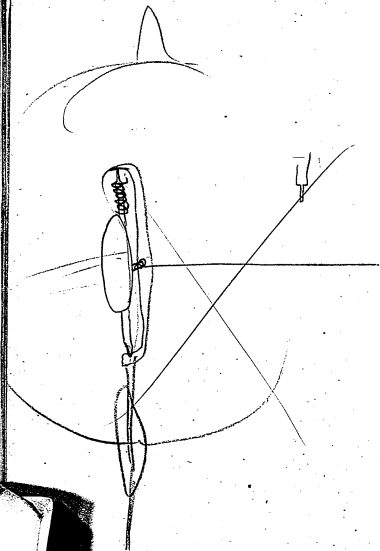
5 or 6 inches

2 inches high



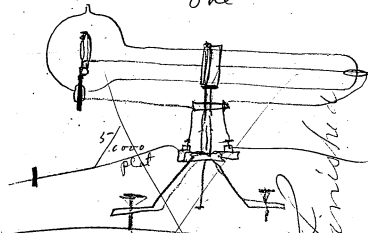
Current Regulation 2  
1 for Water 1 for Mercury





## Thermo Galvanometer

one -

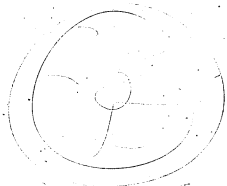


plat -  
10 inches long

 $\frac{3}{4}$ 

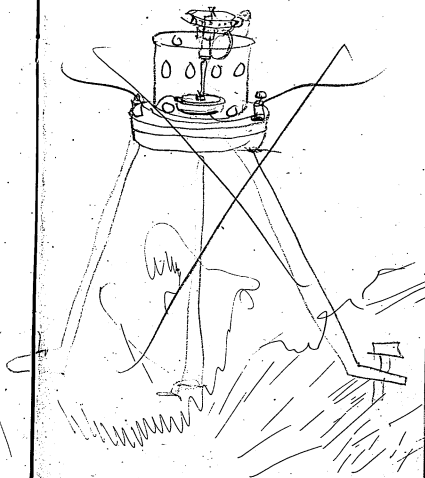
actual

finished

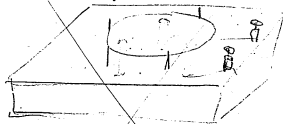


124

Odometer -



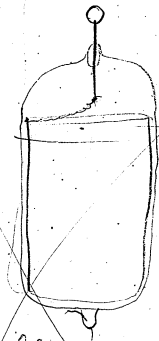
*Made this*



*Sound box*

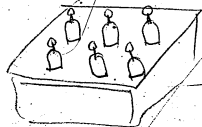
*filler one inch high*

*U*

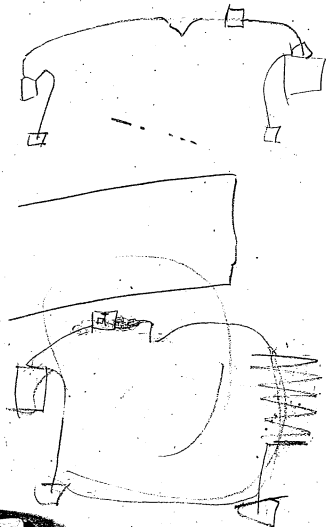


Tunford  
also outside

to be blown in Menlo

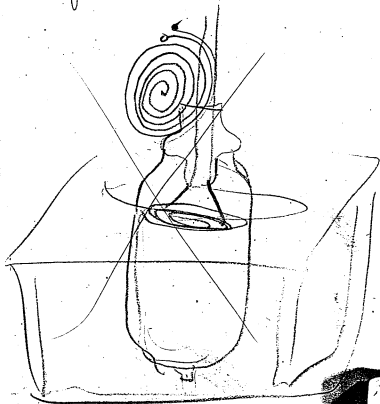


6 of them



Condenser -

3 or 4 feet of tin  
foil & mica

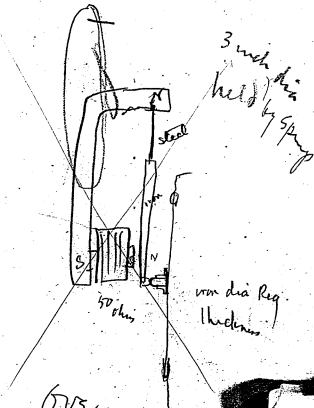


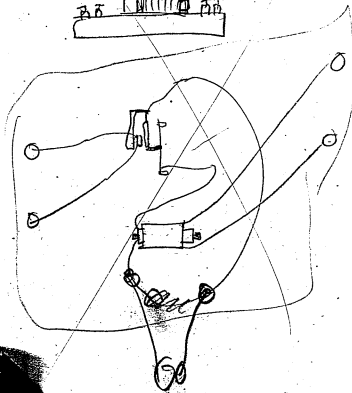
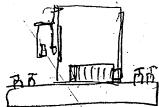
Treasure  
chamber



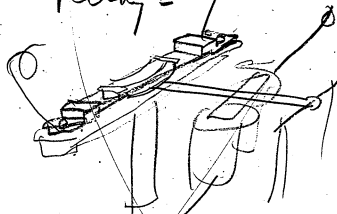
5/2.5/12/1  
8.4

Telephone Receiver

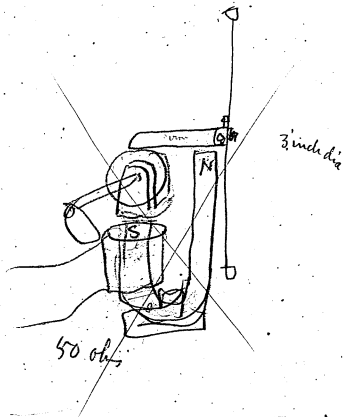




Relay -

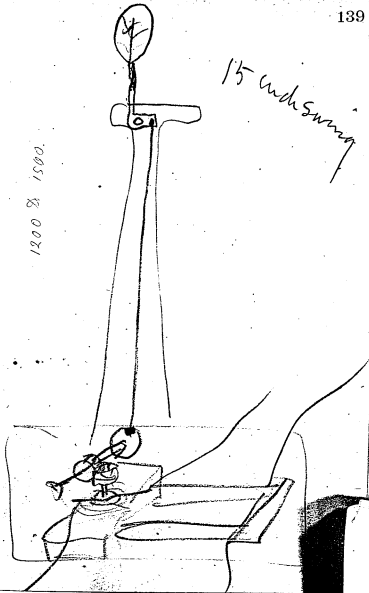






1200 &amp; 1500.

15 inch swing



Dam 3.2 x 5.8 Gasto flu

Gasto 15, 56 lang

flu 15 x <sup>flu</sup>  
15, 25/6

8

$$\begin{array}{r} 54 \\ 3 \\ \hline 162 \end{array}$$

$$\begin{array}{r} 52 \\ 5 \\ \hline 260 \end{array}$$

$$\begin{array}{r} 52 \\ 3 \\ \hline 156 \end{array}$$

$$\begin{array}{r} 208 \\ 23 \\ \hline 624 \\ 1456 \\ 12 \overline{) 15184} \quad 1255 \text{ r } 4 \\ \underline{12} \\ 31 \\ \underline{24} \\ 78 \\ \underline{72} \\ 64 \\ \underline{60} \\ 4 \end{array}$$

$$\begin{array}{r} 162 \\ 73 \\ \hline 486 \\ 12 \overline{) 11229} \\ \underline{1122} \\ 108 \\ \underline{92} \end{array}$$

$$\begin{array}{r} 156 \\ 33 \\ \hline 468 \\ 1092 \\ 12 \overline{) 11378} \quad 948 \\ \underline{108} \\ 57 \\ \underline{48} \\ 98 \\ \underline{96} \\ 2 \end{array}$$

17

$$\begin{array}{r} 6.375 \\ 12 \\ \hline 72 \end{array}$$

$$\begin{array}{r} 12 \\ 3 \\ \hline 36 \end{array}$$

$$\begin{array}{r} 52 \\ 4 \\ \hline 208 \\ 72 \\ \hline 416 \\ 1956 \\ 12 \overline{) 14976} \quad 1248 \\ \underline{12} \\ 29 \\ \underline{24} \\ 59 \\ \underline{48} \\ 96 \\ \underline{96} \end{array}$$

$$\begin{array}{r} 24 \\ 3 \\ \hline 72 \end{array}$$

1265

5

$$\begin{array}{r} 12 \\ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 12 \\ 5 \\ \hline 60 \end{array}$$

$$\frac{12.00}{64} \div 35$$

$$\frac{600}{6000}$$

$$50 \div 6000$$

$$\frac{120}{120}$$

19.1.4

ST

No 19. R 8,8599

$$\frac{16}{32}$$

$$\frac{32}{60}$$

$$12 \div 1920$$

$$\frac{12}{3840}$$

$$\frac{1920}{2560}$$

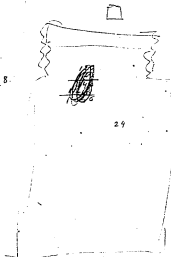
$$\frac{24}{60}$$

$$12 \div 1940 \div 120$$

$$\frac{12}{24}$$

$$\frac{24}{24}$$

$$\frac{12}{90}$$



$$12 \div 1920 \div 108$$

$$\frac{12}{82}$$

$$\frac{72}{100}$$

$$\frac{96}{4}$$

$$\frac{42}{5}$$

$$\frac{220}{220}$$

$$\frac{1000}{200}$$

$$5 \div 780 \div 156$$

$$\frac{1}{28}$$

$$\frac{25}{30}$$



$$\begin{array}{r}
 8 \text{ in } \overline{32} \\
 \underline{64} \\
 192 \\
 12 \overline{) 2016} \overline{) 168} \\
 \underline{24} \\
 81 \\
 \underline{72} \\
 96 \\
 \underline{96} \\
 0
 \end{array}$$

$$\begin{array}{r}
 13 \\
 \underline{65} \\
 32 \\
 \underline{65} \\
 160 \\
 \underline{192} \\
 12 \overline{) 2080} \overline{) 103} \overline{) 10} \text{ in} \\
 \underline{12} \\
 88 \\
 \underline{84} \\
 46 \\
 \underline{36} \\
 10
 \end{array}$$

one ohm resistance 8 in square 13 in long  
 4 ohm resistance 15 in square 30 inch long

$$\begin{array}{r}
 16 \\
 32 \\
 \underline{4} \\
 128 \\
 \underline{260} \\
 2680 \\
 \underline{256} \\
 12 \overline{) 35280} \overline{) 2773} \overline{) 4} \text{ in} \\
 \underline{24} \\
 92 \\
 \underline{84} \\
 88 \\
 \underline{84} \\
 40 \\
 \underline{36} \\
 4
 \end{array}$$

$$\begin{array}{r}
 13 \\
 \underline{4} \\
 52 \\
 \underline{5} \\
 260 \\
 24 \\
 \underline{120}
 \end{array}$$

$$\begin{array}{r}
 15 \\
 \underline{60} \\
 120 \\
 \underline{60} \\
 60
 \end{array}$$

$$\begin{array}{r}
 12 \overline{) 2000} \overline{) 600} \\
 \underline{42}
 \end{array}$$

$$\begin{array}{r}
 173'0 \\
 \underline{4} \\
 692
 \end{array}$$

$$\begin{array}{r}
 30 \\
 \underline{150}
 \end{array}$$

$$\begin{array}{r}
 60 \\
 12 \overline{) 3480} \overline{) 325} \\
 \underline{36} \\
 30 \\
 \underline{24} \\
 60 \\
 \underline{60} \\
 0
 \end{array}$$

$$\begin{array}{r}
 15'0 \\
 60 \\
 12 \overline{) 9000} \overline{) 741}^8 \\
 \underline{84} \\
 60 \\
 \underline{48} \\
 12000 \\
 \underline{12} \\
 682 \\
 \underline{682} \\
 = 59
 \end{array}$$

$$\begin{array}{r}
 52 \\
 \underline{4} \\
 208 \\
 \underline{32} \\
 416 \\
 \underline{1456} \\
 12 \overline{) 4946} \quad 1248 \\
 \underline{12} \\
 29 \\
 \underline{24} \\
 57 \\
 \underline{48} \\
 96 \\
 \underline{96} \\
 0
 \end{array}$$

$$\begin{array}{r}
 54 \\
 \underline{4} \\
 216 \\
 \underline{32} \\
 432 \\
 \underline{1512} \\
 12 \overline{) 5552} \quad 1296 \\
 \underline{12} \\
 35 \\
 \underline{24} \\
 115 \\
 \underline{108} \\
 72 \\
 \underline{72} \\
 0
 \end{array}$$

2

$$\begin{array}{r}
 19941 \\
 \underline{12} \\
 39882 \\
 \underline{19941} \\
 2 \overline{) 2392.92} \\
 119
 \end{array}$$

$$\begin{array}{r}
 686 \\
 \underline{12} \\
 144 \\
 \underline{136} \\
 26
 \end{array}$$

$$\begin{array}{r}
 150550 \\
 \underline{12} \\
 301100 \\
 \underline{2515050} \\
 50150600 \\
 \underline{192} \\
 12080192 \\
 \underline{12} \\
 88 \\
 \underline{84} \\
 40 \\
 \underline{36} \\
 4
 \end{array}$$

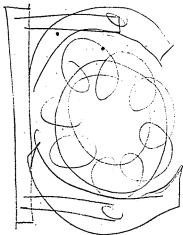
$$\begin{array}{r}
 114.54 \\
 \underline{12} \\
 18
 \end{array}$$

$$\begin{array}{r}
 230.08 \\
 \underline{11454} \\
 1375.48
 \end{array}$$

$$\begin{array}{r} 12 \\ 6.3\frac{3}{8} \\ \hline 72 \end{array}$$

54 x 24

$$\begin{array}{r} 208 \\ 251 \\ \hline 1040 \\ 1456 \\ \hline 12)15600(1300 \\ \underline{12} \\ 36 \\ 36 \end{array}$$



$$\begin{array}{r} 14. \quad 1.5050 \\ 12 \\ \hline 30100 \\ 15050 \\ \hline 2)180600( \\ \underline{90300} \end{array}$$

$$\begin{array}{r} 15. \quad 1.9941 \\ 12 \\ \hline 39582 \\ 19941 \\ \hline 2)239292 \\ \underline{219646} \end{array}$$

$$\begin{array}{r} 16. \quad 2.4466 \\ 12 \\ \hline 48932 \\ 24466 \\ \hline 2)293592 \\ \underline{146796} \end{array}$$



$$\begin{array}{r} 95 \\ 495 \end{array}$$

$$\begin{array}{r} 1000 \\ 475 \\ \hline 7525 \end{array}$$

$$\begin{array}{r} 95 \\ 278 \overline{) 1122125} \\ \underline{950} \end{array}$$

11454

$$\begin{array}{r} 17 \\ 229 \overline{) 11454} \\ \underline{11454} \\ 0 \end{array}$$

6 1/2

3 1/2

18 1/4

18 1/4

18 1/4

18 1/4

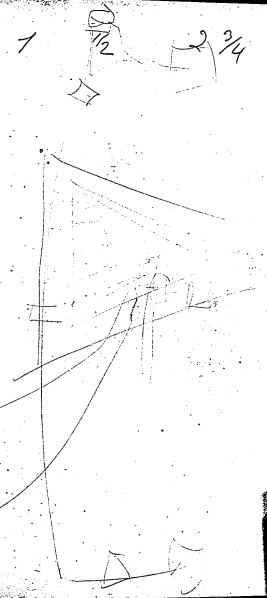
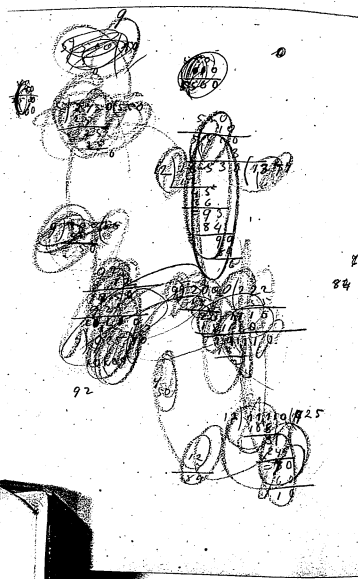
$$\begin{array}{r} 1525 \\ 425 \\ \hline 57525 \end{array}$$

3 1/4

$$\begin{array}{r} 600 \\ 800 \\ \hline 1400 \end{array}$$

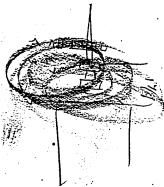
$$\begin{array}{r} 600 \\ 1825 \\ \hline 2725 \end{array}$$

$$\begin{array}{r} 600 \\ 725 \\ \hline 1325 \end{array}$$



$$\begin{array}{r}
 112 \\
 20 \\
 \hline
 2280 \\
 50 \\
 \hline
 11405.0
 \end{array}$$

$$\begin{array}{r}
 50 \overline{) 2280} 45 \\
 \underline{200} \\
 280 \\
 \underline{250} \\
 30 \\
 20
 \end{array}$$

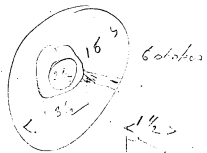


*Water not con*

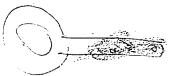


*Lamin*

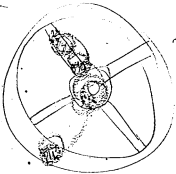




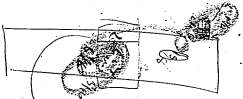
Small pulley

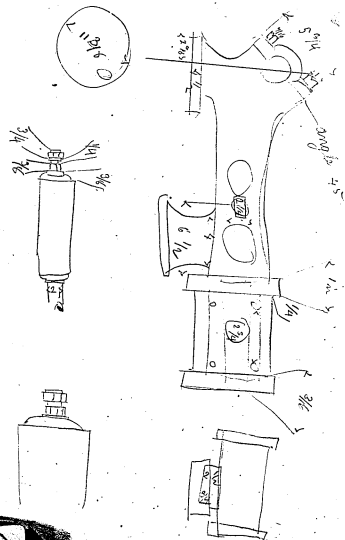


Small pulley



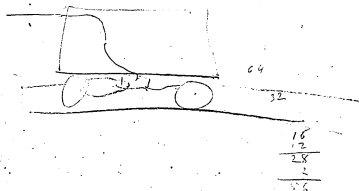
2 spokes

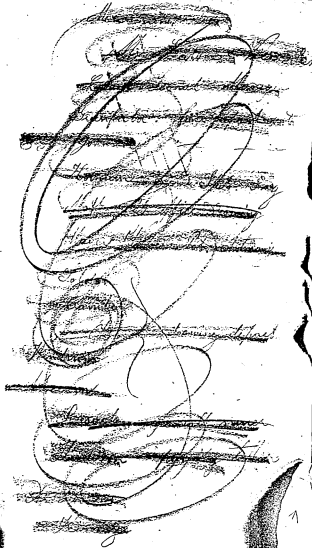




429.485

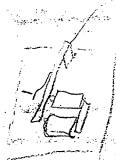
$$\begin{array}{r} 352 \\ \times 16 \\ \hline 2112 \\ 3520 \\ \hline 5632 \end{array}$$





$$\begin{array}{r}
 3.7 \frac{7}{8} \\
 \underline{3.6} \\
 0.1 \frac{7}{8} \\
 \underline{0.1} \\
 0.0 \frac{7}{8}
 \end{array}$$

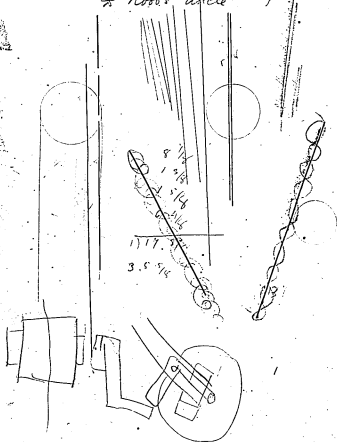
$$\begin{array}{r}
 9 \overline{) 352.39} \\
 \underline{27} \\
 82 \\
 \underline{81} \\
 1
 \end{array}$$



$$\begin{array}{r}
 8 \overline{) 352.104} \\
 \underline{88} \\
 082
 \end{array}$$

$$\begin{array}{r}
 10 \overline{) 352.354} \\
 \underline{30} \\
 52 \\
 \underline{50} \\
 2
 \end{array}$$

Sam E. *Walter Walter Seal*  
 to Rod: Uncle } one



Top

1

3

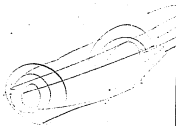
5

Bottom

2

4

6



Menlo Park Notebook #188 [N-81-01-25]

This is one of six notebooks that were probably begun on January 10, 1881. It contains notes on gas lighting and electricity by Charles L. Clarke, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) There are also notes on generators and conductors and eight loose pages that relate to "proportioning the cost of conductors." The label on the front cover is marked "C. L. Clarke." This book contains 284 numbered pages.

Blank pages not filmed: 1, 46-277, 280-284.



Notes on Gas-Lighting.

Consumption.

Rates of -

See Modern Street Lighting  
by Suggs -

Curves of -

Not-

Wanted.

Data on  
only upon  
sheet lamp.

Rate per lamp per hour,

Rate per lamp per quarter,

Hours of burning per quarter,

Statistics upon street lighting  
at Nottingham and Fockstone.

Plot curves for book.

Wanted - Curves of daily  
consumption as to  
time and amount.

Ridicule.

Bessemer process.

Jeans' Steel.

page 54, 49.

" 65.

Entire chapter complete  
with facts of this nature.

Krupp's steam hammer

Jeans' steel.

page 190.

Refusal of Patent  
on the most general  
grounds.

Jennings regenerative  
furnace.

Jennings sketch.

page 104.

Obstruction of Light:  
by globes of different-  
materials and clear  
glass. Table of -

Gas Engineer's Almanac  
by American Meter Co.  
1880.

---

Mixing with air.

Effect of -

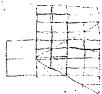
Table of per cents of  
mixture and loss of light.

Gas Engineers' Almanac  
Two tables, American Meter Co.  
1880.

Illuminating Power  
Loss of.

By deposit of hydro-  
carbons in the mantle  
in cold weather.

Statement Gas Engineers Almanac.  
only, written American Meter Co.  
table. 1880.



1 3 5 7

2 4 6 8

## Standard Gas Burner.

16 candles - 24 holes.

3 inch flame

7 x  $\frac{3}{4}$  inch chimney

5 cu. ft. per hour =

16 sperm candles, 6 to 1 lb.

## Residual Products.

Birmingham Gaslight and Coke  
Co. in 1874 <sup>up to June</sup> out of a total  
receipt of 80,000 £. obtained  
7000 £. from residuals and  
needed but 9000 £. to declare  
a 6% dividend. Thus  
 $\frac{2}{9}$  of the sum was obtained  
for this half yearly dividend.

Vol. 18, p. 305. Engineering. Oct. 16, 1874

Total London Companies in 1873

Total received for gas

2 504 402 £.

For products, ammoniacal liquor  
tar, coke, and breeze

950 000 £.



9773  
 236581  
 2300386000  
 9723  
 8634  
 12248643300

# Gas per Ton of Coal.

London Company in  
 first half of 1874 consumed  
 236581 tons of coal, producing  
 2300386000 ft. of gas or  
 9723 ft. per ton.

8634 were actually consumed,  
 the remainder being lost  
 in leakage or consumed  
 on premises. Ordinary Coal used.

Engineering. Vol. 18. p. 305.  
 Oct. 16. 1874.

Total Coal in London Company's  
 in 1873 - 1430931 tons

Costing 1753715.7. Gas sold  
 12,248,643,300 cu. ft.  
 Engineering. Vol. 18. p. 72

*Leakage*

*See page 20.*

Leapitani  
Inveniens.

London

10032-2552. of which  
8 3/4 millions are paid in  
in 1874. Engineering Vol. 18. July 24,  
1874

*Deterioration of Coal.*  
Coal deteriorates by  
exposure to air and  
moisture and causes  
serious loss. and  
companies cannot hold  
large lots.

$437 \frac{1}{2}$   
 $7 \frac{1}{2} \times 17 = 127.5$   
 $2450$

Philadelphia  
Report of Trustees of  
Gas Works. 1880.

| No. of Lights | No. of meters | Total<br>Lights. |
|---------------|---------------|------------------|
| 3             | 50801         | 152403           |
| 5             | 26584         | 132920           |
| 10            | 13157         | 131570           |
| 20            | 4112          | 82240            |
| 30            | 927           | 27810            |
| 45            | 474           | 21330            |
| 60            | 228           | 13680            |
| 100           | 328           | 32800            |
| 150           | 42            | 6300             |

| Lights | Sq. feet<br>of<br>total lights | Sq. feet<br>of<br>meters | Per cent<br>of<br>Total | % |
|--------|--------------------------------|--------------------------|-------------------------|---|
| 3      | 390                            | 225                      | 25                      |   |
| 5      | 364                            | 163                      | 22                      |   |
| 10     | 362                            | 115                      | 21.9                    |   |
| 20     | 287                            | 64                       | 13                      |   |
| 30     | 167                            | 30                       | 4.7                     |   |
| 45     | 146                            | 22                       | 3.6                     |   |
| 60     | 117                            | 15                       | 2.5                     |   |
| 100    | 181                            | 18                       | 5.6                     |   |
| 150    | 79                             | 6.5                      | 1.7                     |   |

## Field of Force.

Speak of the importance of running close to face of field as possible and give calculations on the actual effect of such a change. Make comparison of the relative commercial advantages of getting requisite E.M.F. with high or low internal resistance. For example, as a particular case, is it more economical to make the machine 15 to 1, to get the requisite E.M.F. or give more room so as to get 30 to 1 and obtain the same E.M.F. by strengthening the field by enlarging the magnets and copper?

Draw curves showing for a desired E. M. F. where commercially is the limit of energy which can be permitted to excite the field when compared with the weight of iron and copper, which can be increased in order to decrease the energy expended in exciting the field.

The reason why permanent magnets are not used, the investment would far exceed the cost to excite and electro-magnet, when that cost is capitalized.

### Magnet Tests.

Select three magnets which have recently been rewound and have fiber washers on the ends of the core, and accurately measure their resistance.

Start in the experiment by throwing out the field and then strengthen the field gradually, taking the deflection for every few degrees so as to get points sufficiently close to accurately determine the curve. Take the deflection from terminals of magnet & machine, and measure the resistance of armatures. After the field has been thus run up, bring it down



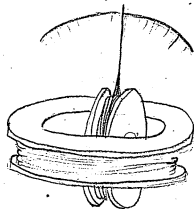
gradually taking the readings  
of the galvanometer as before.  
Take all the readings to right  
and left.

### 2nd Set of Exp.

If dynamo is not giving over  
100 Volts put in the external  
circuit a resistance beginning  
with 1.5 ohms, <sup>as near as convenient</sup> take the deflec-  
tion around the terminals of  
dynamo, Vary the resistance  
increasing it to about 13.5 ohms  
and note the deflections, keeping  
the field constant. Do this  
for the three machines.

3<sup>rd</sup> Ser of Expt.

Electric Dynamometer.



Try

### Impossibilities.

W. H. Preece in Engineering  
Vol. 27, page 81 - Jan 24, 1879

After a long mathematical  
investigation he concludes  
as follows:-

"It is this partial success  
in multiplying the light-  
that has led so many sanguine  
experimenters to anticipate  
the ultimate possibility of  
its extensive subdivision -  
a possibility which this demon-  
stration shows to be hopeless,  
and which experiment has  
proved to be fallacious."

E. M. F. curves -  
John Hopkinson -  
Engineering - Vol XXVII.  
page 403

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By same writer  
Vol XXIX  
page 424

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Conductors. Jan 25-<sup>5</sup> 43  
1881.

The weight and therefore cost of conductors for the same number of lamps varies as the area over which they are distributed.

For example :- If conductors for a central station system of 10000 lights distributed over a certain area cost \$60000, the cost for the same number of lights distributed over twice the area will be \$120000, for three times the area \$180000 and so on.

$$\frac{7}{400}$$

$$\frac{57}{77}$$

$$\frac{10}{57}$$

$$\frac{6}{77}$$

Proof.

Weight of Copper  $\propto$  distance<sup>2</sup>.

Area  $\propto$  distance<sup>2</sup>.

$\therefore$  Weight or Cost  $\propto$  Area.

If lamps are evenly distributed, that is, the same number of lamps for a unit of area the weight and therefore cost of conductors will vary as the area or number of lamps.

Proof Lamps  $\propto$  area

but area  $\propto$  distance<sup>2</sup>

$\therefore$  Lamps  $\propto$  distance<sup>2</sup>

but Weight of Copper per Lamp  $\propto$  distance<sup>2</sup>

$\therefore$  Weight or Cost  $\propto$  Lamps or area.

Wanted.

A diagram showing  
the advantage of sub-division  
over one central light of  
great power, to be shown  
by diagram of circles.



Curve of field magnet-  
3 sizes

Also iron and copper investment-  
at 10% interest, Energy line.

Proportioning  
the  
Cost of Conductors  
so that the  
Interest and Depreciation  
on the  
Cost of Conductors  
and  
Power-Producing Plant  
and,  
Loss of Power  
shall be a  
Minimum.

No. of lamps + size of district const.

- $x$  = Capital Invested in Conductors.  
 $m$  = % interest on same.  
 $n$  = % depreciation.  
 $a$  = cost of producing the energy developed in the lamps.  
 $y$  = loss in conductors.  
 $z$  = ratio of resistance in conductors to resistance in lam.

Proportioning the cost of conductors so that the interest and depreciation on the cost of conductors and power-producing plant and loss of power shall be a minimum.

Number of lamps and size of district constant

- $x$  = Capital in conductors - variable  
 $m$  = % interest - constant  
 $n$  = % depreciation - constant  
 ~~$A K$  = cost of energy in lamps, variable~~  
~~meaning fuel, oil &c.~~  
 $A$  = the amount of energy constant  
 $z$  = ratio of resistance in conductor to the resistance in lamps - variable  
 $AKz$  = cost of energy lost in conductors.  
 $Az$  = the amount of energy lost "  
 $K$  = cost of fuel &c. variable  
 per unit of energy



The actual cost of energy in terms

$$T = (m+n)x + wA(1+g)(t+u) + C(g+r) + S + s + AK(1+g)$$

differentiate and place = 0

$$(m+n)dx + (t+u)wAdg + ds + AdK + AgdK + AKdg$$

$$\text{but } g \propto \frac{1}{x}$$

$$g = \frac{c}{x}$$

$$dg = -\frac{c}{x^2} dx$$

~~unit of energy~~

~~Cost of unit of energy~~

$$\text{but } w \propto A(1+g)$$

$$wA(1+g) = \text{capital invested in power}$$

$$\text{and } AK(1+g) = \text{cost of that power}$$

Let the ratio of capital to cost be R

$$\lim \frac{w}{K} = R \text{ a constant}$$

Total expense

$$T = (m+n)x + (1+g)a + w(t+u) + C(g+r) + S + s \quad (1)$$

in which  $x, g, a, w, S$ , are variables, differentiating and placing equal to zero

$$(m+n)dx + da + adg + gda + (t+u)dw + ds = 0 \quad (2)$$

$$a \propto K$$

$$\therefore a = AK \quad (3)$$

$$da = AdK \quad (4)$$

also

$$g \propto \frac{1}{x}$$

$$g = \frac{c'}{x} \quad (5)$$

$$dg = -\frac{c'}{x^2} dx \quad (6)$$

$$w \propto A(1+g)$$

$$\therefore w = c''A(1+g) \quad (7)$$

$$dw = c''Adg \quad (8)$$

$$S \propto A(1+g)$$

$C$  = Capital invested which would not be altered by change in the amount of power produced, as real estate, pipes for conductors, meters, &c.

$q$  = % interest.

$r$  = % depreciation.

$W$  = Capital invested, <sup>per unit of energy</sup> which is altered in proportion to the change in the amount of power produced, as engines, dynamos, &c.

$t$  = % interest.

$u$  = % depreciation.

$S$  = Executive salaries and like expenses which do not change with amount of power.

$s$  = wages at stations and like expenses which change with amount of power.

Assume that the cost of plant per dollar of power <sup>per year</sup> is  $\frac{1}{x}$  and at  $p\%$  interest and  $q\%$  depreciation.

Then for the general case:-

$$y = qa, \quad (1)$$

$$z \propto \frac{1}{x}$$

$$z = \frac{a}{x} \quad (2)$$

$$c = \frac{a}{z} \quad (3)$$

Total cost of interest, depreciation and power

$$C = mx + nb(a+y) + a+y \quad (4)$$

differentiating we have, placing it at zero

$$m dx + nb dy + dy = 0 \quad (5)$$

from 1 and 2

$$y = \frac{ac}{x} \quad (6)$$

from which

$$dy = -\frac{ac}{x^2} dx \quad (7)$$

substitute this in eqn. 4

$$m dx - \frac{a \cdot b \cdot c \cdot n}{x^2} dx - \frac{ac dx}{x^2} = 0$$

$$\therefore mx^2 - abcn - ac = 0$$

$$x = \left[ \frac{ac}{m} (bm+1) \right]^{\frac{1}{2}} \quad (8)$$

by eqn. 5

$$y = \frac{ac}{x}$$

substituting

$$y = \frac{ac}{\left[ \frac{ac}{m} (bm+1) \right]^{\frac{1}{2}}}$$

$$\therefore y = \left[ \frac{ac}{m(bm+1)} \right]^{\frac{1}{2}} \quad (9)$$

by eqn. 2

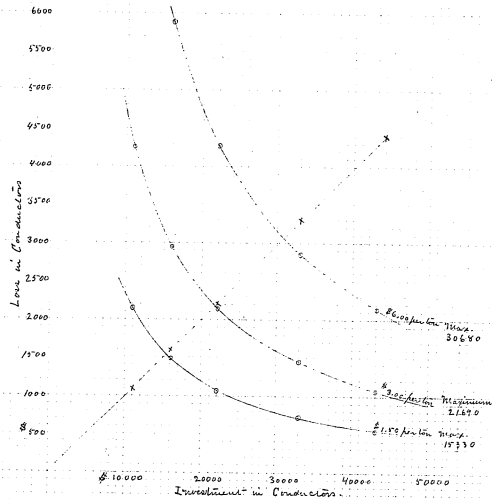
$$z = \frac{c}{x}$$

substituting

$$z = \frac{c}{\left[ \frac{ac}{m} (bm+1) \right]^{\frac{1}{2}}}$$

$$z = \left[ \frac{mc}{a(bm+1)} \right]^{\frac{1}{2}} \quad (10)$$

[ITEM FOUND IN BOOK]



**Menlo Park Notebook #189 [N-80-00-04]**

This is one of six notebooks that were probably begun on January 10, 1881. It contains essays and notes by Edward H. Johnson on gas and electric lighting and on the nature of technological innovation, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) The book contains 284 numbered pages.

Blank pages not filmed: 32-33, 38-39, 56-284.

Rule for determining  
Approximate - the No.  
of gas jets required  
in a given room

The floor area in feet  
divided by 50 for Common  
Gas (or by 70 for Cannel  
Gas) will give the No. of  
burners required for  
Effective lighting

Example

Room 8.0 x 56 = area 4480

$$\frac{4480}{50} = 90 \text{ burners}$$

$$\frac{4480}{70} = \text{Say } 60$$

~~Gas first put in practice  
operation  
by Robt Murdoch of  
Redruth, Cornwall  
publicly showed the  
system in 1797 - in  
1798 made an apparatus  
for the supply of gas  
and lighted neighboring  
workshops & factories~~

Opposition to Railroads  
~~Chas.~~ Am<sup>n</sup> Cyclopaedia  
Stephenson

"While this was building  
the most eminent Engineer  
persisted in recommending  
Stationary Engines in place of  
Locomotives which they declared  
unsafe & incapable of attaining  
high speed; and the clumsy  
expedient of a series of  
Stationary machines 1/2 m  
apart dragging the trains by  
ropes would have been adopted  
but for the energy of Stephenson  
and a few of his friends"

Gas

3

~~Anti~~  
Coal Gas Treatise

~~Anti~~ =

"In our narrative thus far  
we have described the 1st  
Ideas respecting Gases; the  
primitive bases of Pneumatic  
Chemistry; the earliest recorded  
production of inflammable  
air; the spontaneous emission  
of Carbonated Hydrogen from  
the earth & its ignition! the manner  
of the same gas, together with  
the means of storing it, and  
on a small scale as a scientific  
curiosity, its application to lighting  
All these had been observed  
or achieved but there was  
still wanting the mind to  
conceive the mode of applying  
Coal Gas to useful purposes

<sup>4</sup> And the intelligence & carry  
it to a successful issue,

Use this as an analogy

Also from same paper  
in the succeeding Paragraph  
the following:

"We now pass from  
the visionary to the real  
and from the speculative  
to the positive"

Information ~~is in the~~

5

Wicks lighted with Gas  
m<sup>l</sup> 1834 - Ph<sup>l</sup> 1835 =

Phil's Gas works 1880  
Valued at 25,000; w<sup>l</sup>,  
Could not be replaced for  
much less

45<sup>th</sup> annual report Trustees  
Ph<sup>l</sup> Gas works

Wilson's "Commencement for  
Gas Users" -

With ordinary burners instead  
of getting 15 candle light  
from common Gas, 5 or 6 -  
Candles is the rule.  
In Glasgow where the Gas  
is exceptionally good 5 or 6  
Candles is the rule, instead



6. of the 27 candles at which the Gas is Jaffled & instead of the 20 candles that can easily be obtained, the higher the quality of the Gas the greater will be the candle required & thus it so as to get all the light out of it without producing smoke." —

Further

"In some cases Gas is abandoned altogether and replaced by Candles & Oil Lamps because the simple rules for its proper burning have not been understood."

Further

7  
"As the barometer falls the light diminishes and according to Dr. Frankland at the rate of 5.1 per cent for every inch of fall according to Dr. Letheby. In London, the difference in the value of the Light when the Barometer is 31 as compared with what it is at 28 is fully 25 per cent."

~~the Gas~~ <sup>the Gas</sup>  
Thus we have a ~~reduced~~ <sup>reduced</sup> light ~~getting weaker~~ <sup>reduced by atmospheric</sup> change. The same thing may be said of ~~any other form of artificial light~~ <sup>any other form of artificial light</sup>, except light in vacuum or electric light.

<sup>8</sup>  
Further

"Practically speaking when  
Compressed with Wax in Conspicuous  
Candles, placed on a Table  
at least 50 ft. of the highest  
Candle Power of the Gas  
should be deducted to  
allow for the loss by burning  
and glazes the light from  
Table."

NOTE No loss in Edison light  
by deflection burners - No  
loss by filtering through  
Glass Globes - because  
not necessary. In use Globes  
there is absolutely no  
movement of the light  
as when a Gas jet is

disturbed by the air - or<sup>9</sup>  
When the pressure is just  
as to cause it to "blow" =  
These defects in Gas render  
it so painful to the  
Eye that this concealment  
by semi translucent glass  
is resorted to with other  
above <sup>result of</sup> loss of light  
As to height from table  
the E. L. may be used on  
the ~~same~~ plane ~~as~~ the Eye  
since it is so mild &  
steady as not to be painful

# Plans in Steel

Bessemer knowledge of Iron Metallurgy was at that time very limited but this was a great advantage to him for he had but very little to unlearn & much to approach the subject from a basis of knowledge of those who have long since followed a beaten track & vainly endeavored to get out of the rut.

Page 45

Note This may be said of Edison ~~which~~ in respect to the ~~subject~~ his knowledge

of the subject of Electric  
Lighting at the time  
He began the investigation -  
He had never given to the  
subject a moment's thought  
or consideration - He had  
not read any of the literature  
of the subject & was in  
fact perfectly ignorant  
and he was induced to follow the  
suggestions by his own  
curiosity.

Milsons Common Sense  
designed to  
following a table showing  
that Gas is less injurious  
than Oil Wax or Tallow  
is this qualification  
"No doubt these results are  
correct enough but they are  
Laboratory experiments and  
when we apply the quantities  
to actual practice they show  
that Gas is burnt in the  
usual extravagant manner  
is more injurious than any  
of the other systems of  
lighting."

Their Extravagant use of  
the Edin L. can in  
no way ~~create~~  
create a deleterious

Effect - since none exists primarily -  
further.

"It again may be argued that the quantity of sulphur compounds produced at one burning is infinitesimally small & if this quantity be not removed and it becomes deposited on articles in the room - it is only a question of time and number of repetitions for the insignificant quantity to become very formidable collectively."

That gas does injuriously affect Plants, ~~Plants~~ Paintings & decorations

is well settled - hence although as above suggested the injury may be very small at any one period of time - the cumulative effect is very great -

The E.L. not only cannot cause any such deposit - but in the case of plants - <sup>as held by certain authorities</sup> is decidedly advantageous ~~in the case of plants~~

~~on the effect of the E.L.~~  
~~on the effect of the E.L.~~

## Loss of Illuminating Power

Coal Gas is depreciated  
in illuminating power  
to a greater or less  
~~and~~ degree in traveling  
through the mains &  
service pipes, owing to  
the liability, especially  
in cold weather, of  
the Hydro-Carbons to  
be condensed & deposited.

Newhiggings Hunt

3 ~~Went~~

Heavy High initial  
pressure synonymous  
with a heavy leakage of

# Note on Opp. of Fraternity - professional

The ~~for~~ apparently inexplicable  
fact that the highest authority  
in any given art <sup>is so often</sup> ~~is~~ found  
condemning most vehemently  
the infant innovation may  
be explained in this way -  
Naturally, he who becomes the  
most thoroughly versed in an  
existing method, who is the most  
firmly believes in it - who has  
the most thoroughly mastered the  
~~particular~~ ~~method~~ its details  
- is vexed by his fellows and  
the honor of "all things" =

The very firmness with  
which he becomes welded  
to the existing order of  
things closes his mind  
against innovation. He  
has run so long in a  
given groove - that

## Opposition

St. Jean's History of Steel

Ref. to Bessemer's Efforts  
to interest Iron manuf.  
in his New Method of  
Making Steel =

\* Page 54

"One of the ~~1st~~ <sup>1st</sup> to pronounce  
decidedly on Bessemer's Claims  
was Charles Sanderson perhaps  
the most eminent steel manuf.  
in Sheffield and at that  
time a leading authority  
on all questions relating  
to the practical manufacture  
of steel. Sanderson frankly  
admitted that if Bessemer's  
pretensions could be realized

20  
his invention would take  
rank deservedly among the first  
if not the very first of the age -  
but after carefully examining  
the claims of the inventor he  
would not admit them to be  
feasible. He did unhesitatingly  
allow that by the Bessemer  
process a de-carburized cast  
iron was obtained and that  
such iron was bright, white  
and crystalline; but he did  
not believe that such metal  
would admit either of being  
drawn under a hammer  
or rolled into a bar.  
He could not admit the  
Bessemer metal to be  
cast steel. It would not  
make a boring tool or  
a cutter, a tap or a die.  
It could not be fashioned

by the workman's hammer<sup>21</sup>  
made into a needle or cut  
into a file; and in short he  
was compelled to express the  
opinion that it was a metal  
which could not assume  
the commercial value of  
steel; nor would it produce  
a malleable iron suited to  
the requirements of commerce.

Page 55

Moran, whose experience  
of the Metallurgy of Iron  
caused his views to be  
accepted with deference,  
also took up the controversy.  
He pointed out that the  
de-carburization of ~~fluid~~ iron  
the carbon in fluid iron  
run direct from  
~~the~~ blast furnace  
and exposed to the



Action of a blast of atmospheric Air was no new discovery. Numerous small jets of blast were blown into the liquid iron in the old form of refinery furnaces and the intense heat produced by blowing through into liquid iron holding Carbon in solution or combination was well known to intelligent refiners, so that Bessemer's assumed discovery of a great principle resolved itself into the replication of facts that had previously been well known.

Go to Page 30

He cannot get out of it.  
~~He~~ Again - Man is always loth to give up authority - hence rather than wish to find good in the new thing, & thus invert ~~the~~ another with a vestige of his authority he comes to it with a feeling of antagonism which only absolute conviction can remove - This conviction can seldom be effected in the early stages of an invention. Consequently 9 times out of 10 the "authority" fails to see what others with probably less repute but without bias at once comprehend.

~~It is not beyond the~~  
 Again It not infrequently  
 happens that the "architect"  
 has been seeking himself  
 to accomplish the same thing  
 but has only in part  
 succeeded - He is then  
 even more than any other  
 man likely to ~~fail~~  
 find in the solutions  
 offered him numerous  
 defects, observations etc.

It is an even question  
 whether an Engineer  
 in another but kindred  
 profession is not a  
 more reliable judge  
 of the value of the  
 new thing - than one

~~directly~~  
 of the same profession  
 to illustrate - would probably be  
 a Gas Engineer & more  
 competent ~~to~~ to pass upon the value  
 of a system of Electric  
 Lighting than would  
 be an Electrician  
 & Vice Versa -

Opposition

From the inaugural add.  
of the Pres. of the  
Brit. ass. of Gas Managers  
at Bristol Eng. Aug June  
12<sup>th</sup>/77 - as reported in  
the Amer Gas Light Journal  
Aug 2/77 -

Under the head of  
"The Electric Candle"  
a report is given of  
the failure of an Exhibit  
of Electric Lighting to  
which the Pres. had  
been invited because  
of the "break down of  
a Steam Engine without

(Inscribed 1866)

Which the Electric Generator  
Could not be worked"  
~~From this the following  
deductions are drawn -~~  
~~"He says: - He says: -~~  
~~"Inside all which, its cost  
must be such as to put  
out of the question its  
becoming a rival to  
Coal Gas until some  
means be devised for  
collecting Electricity  
of having to employ  
steam power for its  
generation". And again  
in speaking of the same  
attempt to exhibit the  
light - he says "assuming  
however that the thing~~

had been a success  
 its superiority over  
 other Electrical Lights  
 would have been a  
 matter of degree.  
 The inconvenience of  
 a light too powerful  
 for the Human Eye  
 would still remain  
 & the light from one burner  
 would be sure to be rendered  
 by shading to about  
 1/5 of its power to render  
 it admissible for the  
 ordinary purposes of life  
 thus reducing its value.  
 While the cost of production  
 would remain the same  
 it is thus obvious  
 that if the light of

100 Candles be produced  
 & 20 only are available  
 the 80 are obscured and  
 wasted. And there would  
 always remain the fatal  
 objection of its not being  
 disposable beside all  
 which its cost must be  
 great, as to put out of  
 the question its being a  
 rival to Gas was until some  
 means be devised for  
collecting Electricity instead  
 of having to employ Steam  
 Power for its generation.  
 And from this exposition  
 of the subject as it  
 appears to him the  
 following deductions

40 to  
 Page  
 40

from Page 22

Page 56 Beauxemer  
 as indicative of the reception  
 of that the Beauxemer  
 process met with at the  
 hands of the Industrial  
 Press the very great effort  
 Extract from the Practical  
 Mechanics Journal which  
 asked of Mr. W. was not  
 something like a mass  
 was about it? The Iron  
 as refined according to the  
 New process the now find  
 to consist of an agglutinated  
 mass of large brilliant bright  
 grains, possessing of a very  
 perfect malleability - flattening  
 under the blow of a hammer  
 but almost invariably

Cracking at the Edges -

It is wholly destitute of  
 a fibrous ~~structure~~  
 structure and only  
 after having been repeatedly  
 heated and drawn out in  
 a Smiths forge exhibit the  
 properties of an inferior  
 wrought iron



## Water vs. Coal Gas

~~It is~~  
 The hope is held out  
 to the Public that a  
 cheaper & superior  
 Gas is to be produced  
 by new processes.  
 but on reference to  
 the general discussion  
 of the subject of the  
 Relative <sup>merits & demerits of the two</sup> it is found  
 that the new Gas has  
 two fatal defects  
~~first~~ viz: It is a blood  
 poison & by being  
 dependent upon the  
 use of naphtha - of which

There is & can be but  
 a limited supply,  
 - the extent to which  
 it may be manufactured  
 is far within the  
 present limit of  
 Coal Gas manufacture



are drawn -

"But I think I may  
boldly say that there  
is not the slightest  
probability of  
property invested in  
Gas undertakings being  
affected in value by  
any kind of Electric  
Light; and that the  
fear of any such result  
can only be seriously  
entertained by the  
ignorant."

Comments:

It thus appears that  
the most prominent

41  
of British Gas Engineers  
is found ~~raising~~  
indulging in captious  
criticisms and hurrying  
the terrible charge of  
ignorance at those  
who entertain opinions  
not in accordance  
with his: He must  
indeed be a superficial  
thinker if he really  
believed the inability  
of ~~the~~ electricity was  
fatal to its use - Did  
he not know that the  
large engines of a steamship  
work unceasingly for weeks  
at a time during an  
ocean passage - ~~that~~  
if ~~the~~ upon the ever  
moving wave now



much more constant  
upon a solid foundation  
~~that~~ And did it  
not occur to him  
that an Electric light  
station might be  
supplied by a number  
of engines as ~~well as~~ gas  
~~station~~ with  
a number of Reservoirs  
so that when any one  
became unavailable  
another might be  
drawn upon. In point  
of fact the assumed  
insurmountable difficulty  
is fully met by the  
simple & natural expedient  
of having one Extra  
Engine in a station  
~~the rest~~ of 12 -

43  
If one should fail  
the Extra being always  
kept in motion could  
be so instantaneously  
"switched" into connection  
with the Circuit Wires  
as to scarce permit  
of the lights supplied  
of such Circuit becoming  
more than a few  
Candles lower in  
intensity. If a second  
or a third should fail  
simultaneously with  
~~the first~~ the 9  
remaining would still  
suffice as much  
as they needed, &  
~~consequently~~ always  
have a reserve capacity

Equal to such Estin  
Drain. & Even if not  
fully Equal to the task  
the deficiency would  
not appear in a slight  
diminishing of each light  
so slight in fact that  
it would escape the  
notice of at least 90%  
of the consumers & but  
inasmuch as the power  
at any station would  
always be Equal to  
the demand at that  
season of the year <sup>at that hour of the night</sup> when  
the maximum generation  
of light is used. The  
~~coincidentally~~ <sup>break down</sup>  
~~break down~~ <sup>to the engineers</sup>  
would, to say seriously

The power have to <sup>45</sup>  
occur <sup>precisely that season</sup> at ~~such a season~~  
- a combination of  
improbabilities ~~which~~ ~~such~~  
~~slight results as to~~  
~~be~~ pregnant with  
~~a slight~~ results of  
little import as to  
hardly merit a moment's  
thought - much less  
to be magnified into  
a "fatal defeat."

In confirmation of  
this. attention is called  
to the rapid supplanting  
of the Old Reservoir System  
of water supply - by the  
direct supply maintained  
by Steam Engines - More

than

Get Hall's Water works  
Statistics



# Pressure Regulation<sup>47</sup>

Annals Gas Journal  
Sept 3/77

In a paper contributed  
to the meeting of the B.G.  
of Gas managers. Mr  
W. J. Warner of South  
Shields gives some interesting  
data on the subject  
of regulating the pressure  
of gas so as to secure  
uniformity throughout  
the service - and then  
presents some recommendations  
in respect to a remedy.  
He shows the pressure  
throughout the District  
or town is determined  
by the Topography of

8  
The district - It is a  
matter of such common  
occurrence as to form  
within the observation  
of almost every consumer  
having to do with high  
buildings that the pressure  
is greater at the top  
than at the bottom of  
such buildings; beside  
these causes of difference  
due to differences of  
Elevation etc there is  
that of stoppage by  
Kaptalins -  
To determine these differences  
of pressures Mr Warner  
would take the pressure  
"at those positions where  
the mains are diminished  
at the foot, top, & up  
the sides of hills,

49  
along the principal  
streets and at the extreme  
ends of the districts.  
The Pres. of the assn.  
Endorsed & emphasized  
Mr Warner's remarks on  
the subject in the following  
words: "Mr Warner had  
dealt with a most important  
subject - He had been  
personally acquainted with  
many companies in which  
a half dividend had been  
wasted for want of such  
simple means as Mr  
Warner had indicated  
++ The waste which constantly  
occurred for want of due  
regulation of pressure at  
different parts of a dist.  
was most serious.  
In some places there  
would be perhaps 3 or 4

times as much as  
was wanted whilst in  
others there would be  
a deficiency. The constant  
source of complaint  
"arrangement" =

all this is of course  
due to the fact that  
gas being lighter than  
air ~~is naturally~~  
rises with a pressure  
proportional to the ~~length~~  
~~of the column~~ its  
~~height of elevation~~  
height of the column  
since this varies with  
the topography of the  
dish, it follows that  
~~no~~ Each dish must  
be considered by itself

in any attempt to <sup>51</sup>  
Establish uniformity.

~~Although~~ raised  
with an initial pressure  
of 20 inches the pressure  
~~the~~ at various  
points throughout the  
Dish may vary ~~by~~  
several inches

~~Although much has been  
said about the difficulty  
of providing the  
Electric Light System  
with a practical regulator  
the ~~fact~~ ~~is~~ ~~that~~ ~~the~~ ~~present~~  
~~the~~ ~~operation~~ ~~of~~ ~~the~~  
Lamps & the development  
of the Edison System  
has so completely ~~ruined~~  
the matter from the~~

~~Sphere of Importance~~ it  
has. The providing of  
a practical Regulator  
for the Electric Light  
has always been held  
to be of almost as  
Vital importance as the  
invention of the lamp.  
Yet we ~~now~~ find ~~the~~  
by the invention of  
the Lamp and the  
practical development  
of the Edison System  
the matter is taken from  
this sphere of importance  
& reduced to such  
simplicity & efficiency  
as to be absolutely  
free from. Even a  
single one of the

53  
defects of Gas is above  
depicted - Electricity  
not being affected by  
~~the~~ ~~quantity~~ Elevation  
or Kindred influences  
and having, in fact, no  
~~retarding~~  
and being subject to no  
Other retarding or accelerating  
influence than the  
simple resistance of  
the conducting wires.  
The pressure may be  
wholly & absolutely regulated  
& controlled at the  
Central Station -  
That this is so, and that  
any change of pressure  
at the Central Station  
produces a corresponding

Variation at Every  
point of the supply  
mains may readily  
be proven to the satisfaction  
of any one, however  
unprofessional he may  
be - by observing any  
one or more of the  
800 Lamps in operation  
at Meuld Park. The  
variation will be exactly  
the same ~~on~~ ~~top~~ in  
the Lamps on the Top,  
Side or Bottom <sup>at top</sup> of a  
Kiln <sup>and</sup> equally in  
the nearest or  
most distant Lamp =

~~At the same time~~

From this it ~~follows~~  
follows of course  
that the pressure on  
the Lamps located

on the ground floor <sup>55</sup>  
will be no more & no  
less than that on  
those at the highest  
point in the House

Menlo Park Notebook #190 [N-79-07-12]

This is one of six notebooks that were probably begun on January 10, 1881. It contains quotations and references from technical literature and trade journals on gas lighting and electricity, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) All of the entries are by Edison. The label on the front cover is marked "Small notes - phrases." The book contains 284 numbered pages.

Blank pages not filmed: 8-284.



LIBRARY OF THE  
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

*From Library,*  
GENERAL-ELECTRIC.

44 Broad St. N.Y.

May 1, 1896

1

"The delicate operations on which  
the lighting of a town depends."

Coplands Lecture in B gulf Lighting  
April 29 1871 in referring to gas

dittos

"The receipts for public lamps  
both in London & provinces being rarely  
more than 5 per cent of annual rental."

dittos "so the gas consumer has 16  
candle gas passing through his meter  
& something like 10 candle gas  
being consumed at his burner"

ditto Copland =

"The Electric Light has yet many difficulties to conquer which will require an enormous amount of energy & resources."

"It is comparatively easy to  
kindle a great light, and dazzle the  
eyes of the multitude & the latter  
hardly care at present what the light  
costs, or whether it can be made  
available for common use."

"The Electric Light if used generally ~~is~~ without styles must always be a calm, searching and peculiar illumination"

Hjorth - see if he has any paper in  
 Royal Soc Cat - L Clarke says he's  
 first make dynamo self magnetizing  
 field -

5

The Scientific amn July 12 /79  
 9 notice piece taken from Newcastle  
 on Tyne - Chemical Society's Journal  
 speaks of Swan having lamp  
 on incandescent principle with  
 "Cylinder" Carbon = got original  
 paper - "Carbon pencil" speaks of

Eng pat 2264 - GPP by E  
 G Groun & R Sennet  
 Hydrocarbon vapor around arc  
 Carbons get it - perhaps store  
 my bundle -

Average dividends paid<sup>3</sup>  
on English RR unincorporated

4.16 per cent - Total unincorporated

~~£474,000,000~~, Great Britain &  
Ireland 1868. (get later date)

£502.262.887 1/2 (actual paid)

**Menlo Park Notebook #191 [N-81-01-21]**

This is one of six notebooks that were probably begun on January 10, 1881. It contains essays and notes by Edison and Edward H. Johnson on gas lighting and electricity, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) There is also a draft of a letter from Edison to Uriah H. Painter asking him to obtain publications of the Bureau of Statistics, including industrial statistics from the new census. A note indicates that the letter was written on January 21, 1881. The label on the front cover is marked "notes & mem. of phrases." The book contains 284 numbered pages. The pagination is irregular; some page numbers are duplicated while others are missing.

Blank pages not filmed and missing page numbers: 6-7, 28-229, 231-249, 251-261, 263-281, 283.

LIBRARY OF THE  
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

*From Library*

44 Broad St. N.Y.

May 1, 1896

1  
Opposition to Gas -

= objection on the score of  
Shutting off all lights at once  
- what would become of Gas  
there being no reservoir

Note Edison suggests the reply  
to this shows the Gas trouble  
to have had his system  
as ill, digested as Swan-  
-wick's series - not a practical  
way - See Pamphlet

Practical  
"A treatise on the ~~use of~~  
+ ~~Practical of the~~ manufacture &  
Distribution of Coal Gas."

~~Vol 1 - Dec 1896 - Page 17~~

Page 18

Quote from above work  
a Ref to proof of pract.  
utility of Gas -

Make Analogy to Edison's Lita

Page 20 ~~and~~ drive

HC Paragraph

~~Evolution in Gas~~  
 Early  
Information

Gas 1<sup>st</sup> applied to useful  
 purpose of lighting by W<sup>m</sup> Murdoch  
 Ayrshire Eng -

Discovered it in 1792  
 applied (to his House) 1797  
 Public Display 1802

1<sup>st</sup> lighting of Sts by Gas  
 Pall Mall by Winsor 1807  
~~Westminster Palace 1808~~

1<sup>st</sup> Public Co formed in 1810  
 in London - by F. A. Winsor  
 "Gas Light & Coke Co"



Even the best Engineers at  
 the time thought that  
 to operate a Locomotive  
 it was necessary to toothed  
 driving wheels running  
 on toothed rails and  
 innumerable patents were  
 taken out & schemes proposed  
 for overcoming this imaginary  
 difficulty " Chambers Encyclopedia

" It is shown in this as in the  
 analogous case of steamships  
 that the world may remain  
 sceptical long of an invention  
 long after it has been practically  
 established beyond cavail -"  
 (RR in Chambers Enc)

See Newdigging handbook pgs  
 139 <sup>also 121 & 120</sup> = size of pipes  
 requires pipe a house  
 without different lights -  
 then get Morris Taskers price  
 list and get cast sample  
 house - then do same  
 on our system, then  
 show that yearly increase  
 in gas consumption is so  
 much (get from Phila & London Co  
 report & assume it for all County)  
 & thus show annual  
 saving that will accrue to  
 public -

For. Electric Engs book -

Copy handy rules Newbigging  
Handbook page 145 =

ditto. Loss light by globes.  
144 = of Newbigging

also table = Newbigg-  
p 151 - Comparative Cost  
different Illuminants -  
adding our Kerosene.  
This table also to go in  
Prospectus Book  
~~substituting~~

Prospectus Book -

Visiting Effects def ill agents.  
P 152 - Newbigging Handbook.

also salubrity - page 152  
Newbigging

"Structural Value" has reference  
to the amount of Capital expended  
upon works in their construction.

"Commercial Value" is the value  
of the net annual average  
profits reckoned on a number  
of years which a firm or Co  
can make by the use of their works.  
Newbigging 169 -

Numbering 169 =

Good

The average cost of gasworks in provincial towns about £1 per head of population. In very large towns amount to more; and in small towns want as much that sum.

Average cost gasworks per Million Cubic feet gas produced per annum is from £700 to £800.

Population per mile of main is usually 2000 people in densely populated towns will rise to 3000 people; but in fashionable places where houses are wide apart population per mile of main will fall below 1000.

Average consumption gas per mile of main is from  $2\frac{1}{4}$  to  $2\frac{1}{2}$  million Cf per annum

Ed Engine Hand Book 19.  
 a good Collector will deliver  
 on an average 400 gas bills per day

Books required in system:

General Ledger.

" Cash Book

Consumers Ledger

Large Consumers Ledger, handles the regular  
 themselves

Removals Book - In this book is  
 kept an account of all changes  
 residence consumers during each  
 quarter - the substitution meters  
~~Consumer~~ Candle power used by  
 temporary consumers. This book  
 prevents confusion by substitution  
 in req. regulations. 002

Daily Receipt book (cash)

In which are entered amount  
Each separate payment made  
to Co on account. Light p

Block Book - record of bad  
debts.

Balance Book:

Sci 171 Newberrington -

The amount of gas consumed in London  
for street lighting is less than 10  
percent of total sales (see if <sup>6</sup>/<sub>10</sub>)

In Salford Eng - only <sup>6</sup>/<sub>10</sub> percent  
if you add large public  
works then want come to 10 p.c.  
get other data on this subject,



Thos Newbigging President of the  
Manchester Inst Institution  
of Gas Engineers says that  
the Council computation there  
is expended on gas undertakings  
in the United Kingdom no less  
than £60,000,000. Representing  
an investment of not less than  
£110,000,000.

Get statistics & notes to  
make up this -

The following Examiners  
opposed R.R.

ditto Steamboats.  
Atlantic Cable

Telegraph

Bessemer

Gas.

Cable

& other industries

$$\begin{array}{r}
 4,000,000 \\
 390,000 \\
 \hline
 4,390,000 \\
 17,216,000 \\
 \hline
 21,606,000 \\
 3,400,000 \quad ) \quad 21,606,000 \\
 \underline{20,400,000} \\
 1,206,000
 \end{array}
 \quad (6,30$$

## Miscellaneous

Quote from Pamphlet

"A Treatise on the Science  
+ Practice of the Manufacture  
+ Distribution of Coal Gas

Page 28-

"The Indispensable requirements  
for the manager, or more properly  
speaking Engineer, of such  
an undertaking were good  
Mechanical Knowledge and Skill  
some acquaintance with Physics  
generally, an inventive mind  
together with considerable Energy  
+ perseverance. No mean  
combination of qualities  
at any time, but at  
that period exceedingly rare

And unfortunately for the <sup>250</sup>  
the success of the Co. the Directors  
did not understand these  
qualifications the essential  
in their Engineer. As their choice  
for that Post fell on William  
a Chemist to be aided  
by a Gas engineer a medical mind  
- Some reason may be assigned  
for the appointment of the  
first, but it must be doubted  
whether the necessary knowledge  
of Vapors + Distillations could be  
if much assistance in  
the laying of mains + fittings

Apply Telephone in England

|         |         |         |
|---------|---------|---------|
| 3 Right | 152 403 |         |
| 5 "     | 132 920 |         |
| 10 "    | 131 570 | 41 6893 |
| 20      | 82 240  | 82 240  |
| 30      | 27 810  | 49 9133 |
| 45      | 21 330  |         |
| 60      | 13 680  |         |
| 100     | 32 800  |         |
| 150     | 6300    |         |
| 200     | 2000    |         |
| 300     | 6300    |         |
| 500     | 5500    |         |
| 1500    | 3000    |         |
| 2000    | 4000    |         |
| 4000    | 16000   |         |

21 5260  
82 240  
133 020

21  
300 light  
6300

3 light

11  
500 light  
5500

50801

32

26584

5 light

152403

132920

1500 light  
2  
3000

13157

10 light

150 light  
4  
600

2000 light  
2  
4000

131570

4112

20

light

328  
100 light  
32800

82340

228  
50 light  
13680

474

47 light

2370

1896

2133

927

30

light

27810

4 of 4000 light

16000

$$530,000. / 2.180,000 \text{ Ms } (4)$$

$$\underline{2180000}$$

$$\begin{array}{r} 5300000 \\ \underline{25} \\ 2650000 \\ 1060000 \\ \hline 13250000 \end{array}$$

$$\begin{array}{r} 5300000 \\ \underline{25} \\ 2650000 \\ 1060000 \\ \hline 32500000 \end{array}$$

25°C Labor

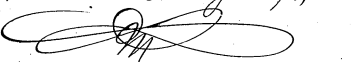
$$1.892,000 / 2.180,000 (1)$$

$$\underline{1892000}$$

$$288,000$$

WMP

Put all the Publications  
of the Bureau of Statistics  
— of any Statistics in  
the new Bureau have  
been prepared (Industries)  
If to hand them  
on —

Written Jan'y 21/89  


$$\begin{array}{r} 250,000 \\ 300 \\ 8 \overline{) 75,000,000} \\ \underline{937} \quad 250 \\ 300 \\ 8 \dots \end{array}$$

20

$$18,000,000$$

10.

ms

$$\begin{array}{r} 532 \overline{) 2,180,000} \\ \underline{1,596} \quad 3 \\ 584 \quad 4 \end{array}$$

8

$$\begin{array}{r} 3,000,000,000 \\ 1,300,000,000 \\ \underline{4,000,000,000} \\ 1,200,000,000 \end{array}$$

$$\begin{array}{r} 900,000,000 \\ 250,000,000 \\ \underline{45,000,000,000} \\ 180,000,000 \\ \underline{2,250,000,000} \end{array}$$

Menlo Park Notebook #192 [N-78-12-15.2]

This notebook dates from December 1878. All of the entries are by Edison and relate to work on the electric light. There are notes on carbon, platinum, and other materials; calculations and notes on gas, including comparisons of calculations made by Moses Farmer and Edison; notes and drawings relating to electric power distribution and the need for high resistance lamps; and drawings of lamps and generators. The label on the front cover is marked "short notes - phrases" [crossed out]. The book contains 59 numbered pages.

Blank pages not filmed: 55-59.



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120 BROADWAY, NEW YORK.

Gen. Library  
GENERAL REG. DIV.  
44 Penn St. N.Y.

May, 1890

Notes

Experiments.

Try fusibility of pumice stone, also of  
Electro silicon, also oyster shells.

Plaster Paris - 1 pt to  $2\frac{1}{2}$   $H_2O$ ,

make ~~Hot~~ damp block from  
naphthalin =

Dolomite, has been used  
by Crocker for cylinder in  
the Oxy Hydrogen flame, it doesn't  
splinter, or crack like Lime or  
magnesia.

$$\begin{array}{r} 15 \\ 36 \\ \hline 90 \\ 45 \\ \hline 540 \end{array}$$

Farm 1500 - 540  
750 - 270  
325 - 135

③

$$7 \overline{) 135}$$

$\frac{3}{5}$  7

$$\begin{array}{r} 10\frac{1}{2} \\ 5\frac{1}{2} \end{array} \quad \begin{array}{r} \frac{6}{16} \\ \frac{3}{12} \end{array} \quad \frac{3}{4}$$

$$7 \overline{) 325}$$

$\frac{3}{16}$

21 feet 20.

6

63 -  $\frac{3}{4}$   $\frac{1}{8}$

$\frac{3}{8}$

20  $\frac{1}{2}$

31  $\frac{1}{2}$  1  $\frac{1}{2}$

$\frac{9}{4}$

10.6 5.3

15  $\frac{3}{8}$  3



1  $\frac{1}{2}$

2.7 mil

34

1.3  $\frac{1}{2}$

6

15  $\frac{1}{2}$

7  $\frac{3}{4}$

Wilds Muck

7 horse power heated  
red hot wire No. 16. 21 feet  
long - surface 3 calculate to  
Gr about 6 x 7  $\frac{3}{4}$

J. fig 1  $\frac{1}{2}$  gas jets per hp - with Farm  
100 cp per inch 3 gas jets per hp



2 ohm



1 ohm

1000, 6 cells;  
4000, 12

12 cells,

4

4 ohm

25

50,-

3

1000,

24

58

12 cells, each 1333. 4 ohms.  
 1 coil ~~100~~. 100 ~~each~~ 4000 ~~per~~  
 2 - 8 ohms, 3-100 = 50, 1000 each.  
 24 cells, — 2 coils each, 4000 deg

40

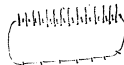
12 cells - 4 ohms.

25 4 at 25, 4 at 25 each - 6  $\frac{1}{4}$  ohms  
 $\frac{25}{12 \frac{1}{2}}$  4 at 100. 25 - 1000 deg.  
 8 " 12  
 16 6.

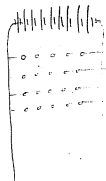
1 100  
 2 30  
 4 25  
 8 12  $\frac{1}{2}$   
 16 6  $\frac{1}{4}$

100 cells. 100 ohm

9



100 - 8 ohm lamps,



10 lamps in 10 series,

|   |      |
|---|------|
| 1 | 1000 |
| 2 | 500  |
| 4 | 250  |
| 8 | 125  |

|    |       |
|----|-------|
| 10 | 10000 |
| 20 | 5000  |
| 40 | 2500  |
| 80 | 1250  |

|    |       |
|----|-------|
| 1  | 10000 |
| 2  | 5000  |
| 4  | 2500  |
| 8  | 1250  |
| 16 | 625   |
| 32 | 312   |
| 64 | 156   |

40:

8

64  
58  
45  
35  
30  
20

300  
150  
150

(11)  
If you have 100 lamps each of  
1 inch radial inc. surface and  
each of arc resistance of 1  
ohm all connected in series  
and to a battery which will  
keep them warm & start them  
you can make 100 lamps of  
100 1000 or 10000 ohm resistance  
arranging them so the ~~res~~  
Carbon resistance of the  
whole equal that of the 100  
1 ohm lamps in series and the  
result will be the same  
but for general lighting  
the high resistance <sup>lamp</sup> will be  
the best not because it is  
more economical but because

This impracticable to  
 work in series and all  
 lamps given to consumers  
 must be in multiple arc  
 hence at a mile distance  
 1 one ohm lamp would  
 require a conductor having  
 a resistance not over 0.2  
 of an ohm whereas a 10000  
 lamp might have at conduct  
 of .1 10 50 or even 100 ohm  
 without materially weakening  
 the ~~the~~ means.

$$\begin{array}{r} 250. \\ 125. \\ \hline 100. \\ 400. \end{array}$$



2. 1000.

1000 1000

1000 1000

|     |        |
|-----|--------|
| 1   | 1000   |
| 2   | 500    |
| 4   | 250    |
| 8   | 125    |
| 16  | 62 1/2 |
| 32  | 31 1/4 |
| 64  | 15 5/8 |
| 128 | 7 3/4  |
| 256 | 3 7/8  |

|      |         |
|------|---------|
| 1    | 30000   |
| 2    | 15000   |
| 4    | 7500    |
| 8    | 3750    |
| 16   | 1875    |
| 32   | 937 1/2 |
| 64   | 468 3/4 |
| 128  | 234 3/8 |
| 256  | 117 1/4 |
| 512  | 58 5/8  |
| 1024 | 29 1/4  |

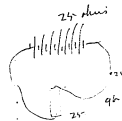
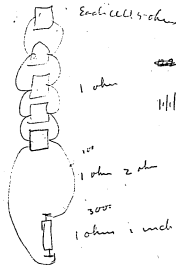


$$\begin{array}{r} 65 \\ 3 \\ \hline 195.000 \end{array}$$

|       |
|-------|
| 2048  |
| 41096 |
| 8192  |
| 16400 |
| 32800 |
| 65600 |

|        |
|--------|
| 14 1/2 |
| 7 1/4  |
| 3 5/8  |
| 1 3/4  |
| 7/16   |





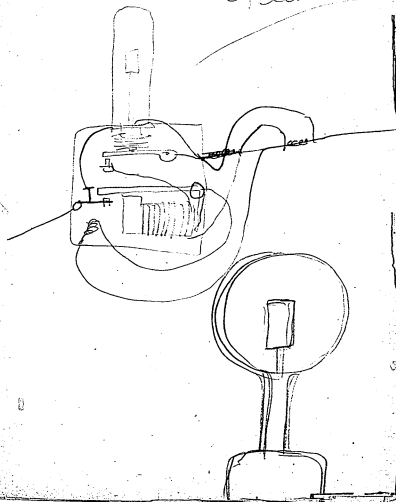
1  
 2  
 4  
 8  
 16  
 32  
 64  
 128  
 256

1000  
 500  
 250  
 125  
 62.5  
 31.25  
 15.625  
 7.8125  
 3.90625

512  
1024

1.95  
.95

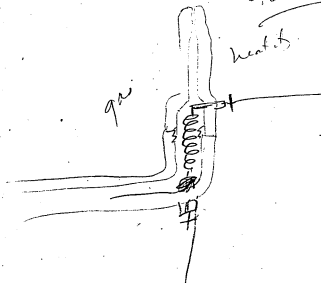
Dec 15 1878  
T. Edison

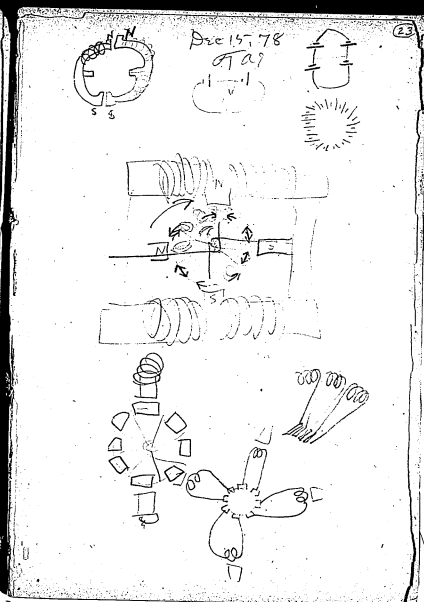
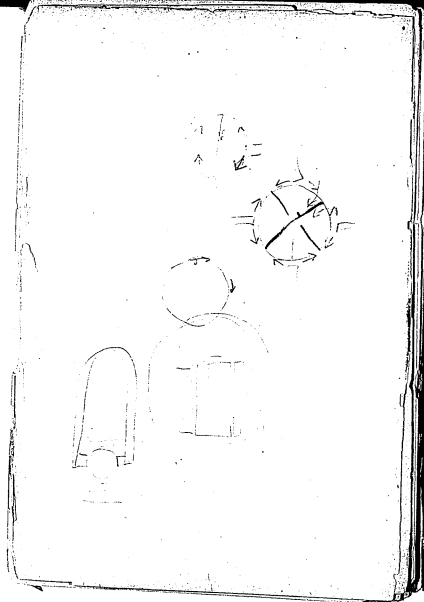


Dec 15 1878

Gardens

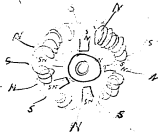
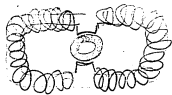
heat b.





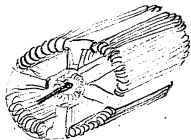
Dec 15-78  
Tas

(25)

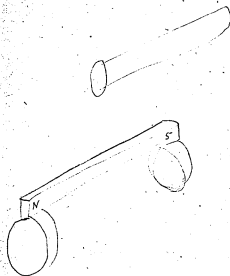


Dec 15 1878<sup>(27)</sup>  
TAE

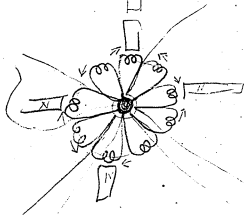
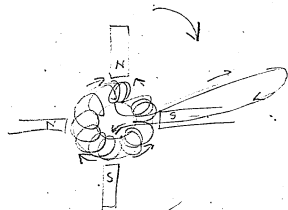
New magneto.



Dec 13-78  
gas

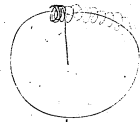
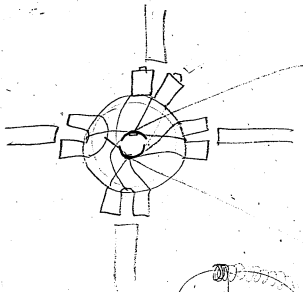


Dec 15, 78  
T. A. i



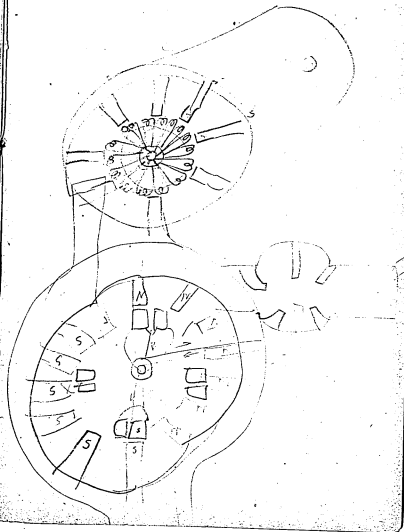


Dec 15-78  
9 a.m.



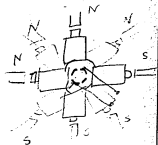
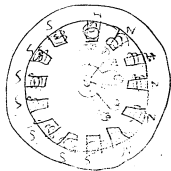
Dreiss = 78  
1 a 1

35

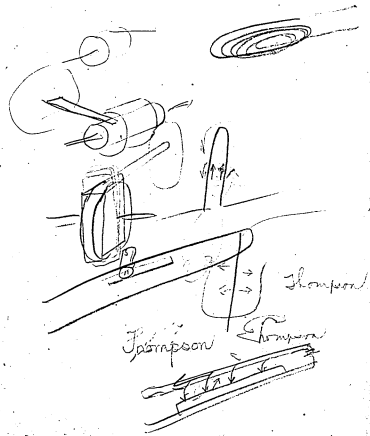


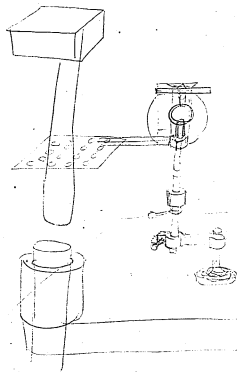
Dec 15-78  
Tue

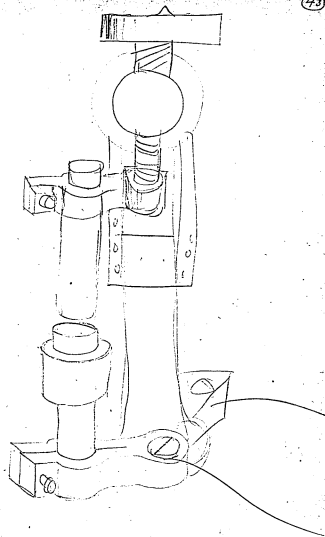
(37)

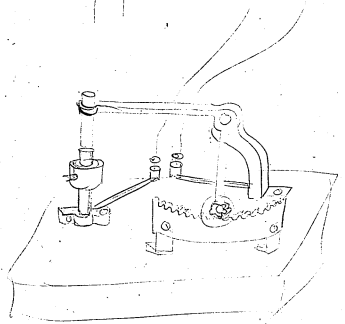


Dec 15, 78  
T. A. i



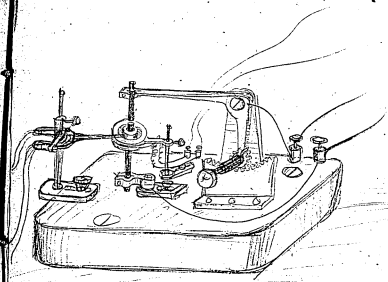












60 of chromum & 40 iron not attacked  
by Aqua Regia - white & color glass

Platinum found in: France -  
Germany -

Platinum is sometimes alloyed with the platinum metals  
palladium, Rhodium, Osmium -  
Iridium, Ruthenium, and alloyed &  
associated with Gold, Silver, Iron,  
Manganese, Copper, and Tin, &  
Zinc, Chromic Zinc.

Glass

when transparent glass is  
maintained for some time at a  
high heat, but below fusion, it  
becomes opaque or brownish or  
fibrous in structure, & the  
consequence of heat & elongation  
its so much harder that it  
scratches glass. will bear  
sudden changes of temperature

like porcelain, it is  
commonly called devitrified  
glass or Peacock's porcelain, but  
its proper name should be crystalline glass.  
This change is most readily effected  
with bottle or window glass.

**Menlo Park Notebook #197 [N-82-06-08]**

This notebook covers the period June-August 1882. Most of the entries are by Edison. There are also a few entries by Charles Batchelor. At the beginning of the book are notes by Batchelor on a record-keeping system for electric light companies. The remainder of the book contains notes and drawings by Edison, many of them for a draft caveat concerning lamps, generators, arc lights, and methods for regulating the electromotive force of the current. The label on the front cover is marked "Book Keeping for Electric Light." The book contains 280 numbered pages.

Blank pages not filmed: 122-123, 140-145, 156-197, 216-265, 272-273, 276-279.

Carburetor for Elco Arc  
are Lamps.  
fuel & Regltn.  
Secy. Gathens.

Reciprocating Dynamoe  
Coasting wire with Lead  
with iron pipe  
Zinc pipe

LIBRARY OF THE  
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

From Library  
of the Board of Patent Control  
44 Broad St. N.Y.

May 1, 1896

A system for keeping the 1

Histories and Accounts of  
Electric Lighting Companies

with the necessary forms

for such Companies

# Superintendent's Department<sup>B</sup>

Relating to the manufacture  
and distribution

First the Superintendent should  
have a plan of the central  
station with the location of  
every ~~steam~~ boiler, general  
steam connection, pumps, heaters  
also every Electrical connection  
and position of the mains as  
they leave the ~~central~~ station  
building.

he should also have a  
plan of all main wires and  
connection boxes etc

These plans should be kept  
in a frame and should be  
easy to remove to make any  
necessary alterations -

6

Reading of water meter  
Ashes thrown out.

Book 1

Boiler Room Account.

7

[illegible]

His to Rgt by the Boiler room attendant



Book 2.

Engine Room Account

-9

Date — Pressure, Steam

No of hours for each engine <sup>1 2 3 4 5 6</sup>

Total Consumption

~~Consumption not checked~~

[illegible]

~~Subcontractor~~  
 2 Engineers  
 2 keepers  
 2 Regulators  
 2 Firemen  
 4 Laborers 1 Wiper  
 Lamp boy

---

Chief Engineer is supposed  
 to have full charge of  
 everything & to be able  
 to attend to accidents in  
 case of necessity

---

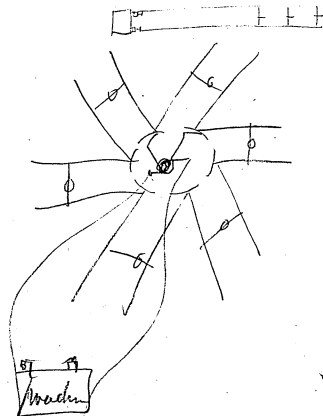
Executive Office  
 Has Charge of  
 New houses (putting in)  
 Making renewals  
 Putting new plant  
 repairs  
 supplies  
 and executive duties  
 paying wages.

The Street Lamps will  
 be of given candle power  
 and be charged for <sup>length of</sup> the time  
 they burn.

The Street Carriages will be taken<sup>15</sup>  
direct from the main -

---

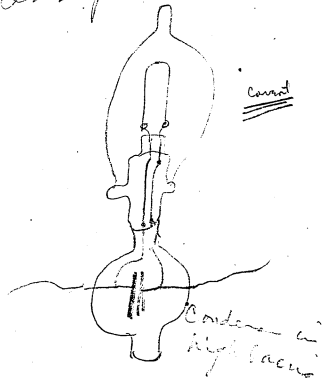
June 8 1882 17  
Pekin, E. M. - 722



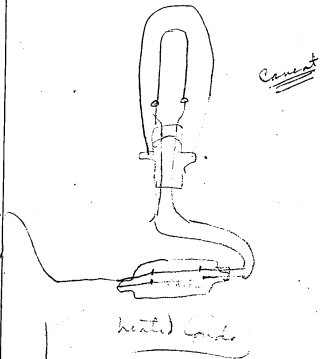
June 8 1882 TA 19

June 8 1882 TAG 21

Precaution Carrying in  
Lump



June 8 1882 Feb 23  
Prenatal Electrical  
Company -

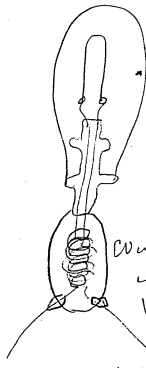




Experiment Electric Canning

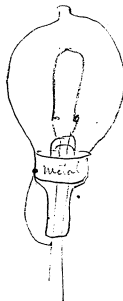
June 8 1882

Tae

Current

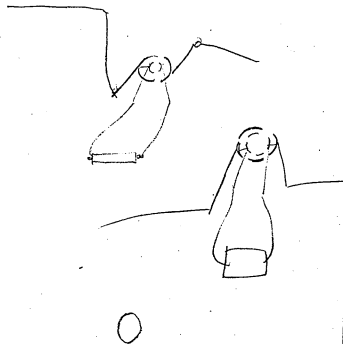
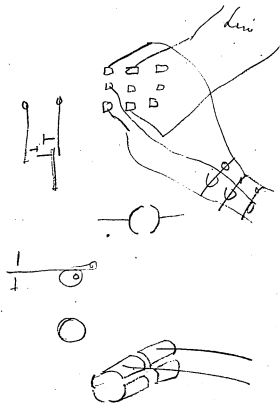
Wire Cords  
in or not in  
Vac

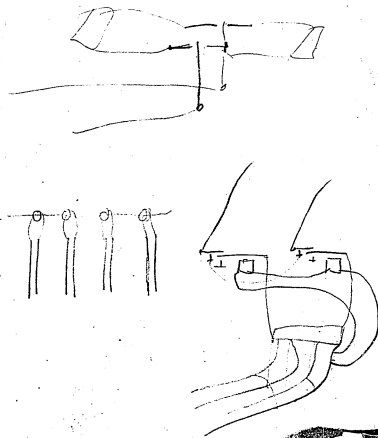
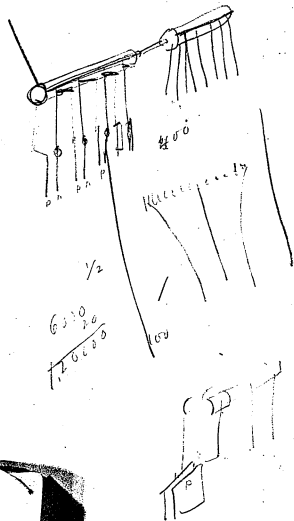
Expts. Electrical Conjugation



June 8 1882

TasCaut

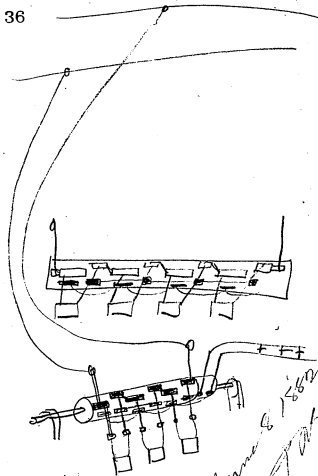




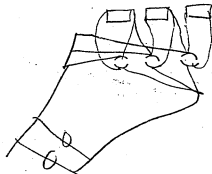
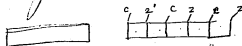
June 8 1882 TAE 33

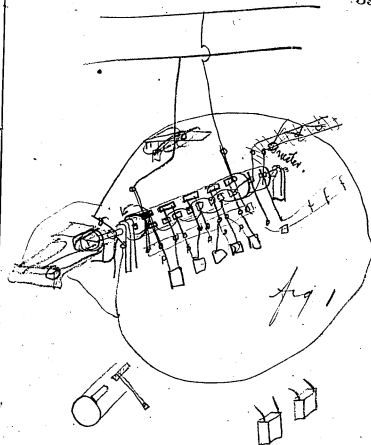
I propose to use 200 double plate  
cells of lead only exceedingly close  
together probably like a dry pile  
with moistened wool between  
with  $\text{SO}_2$  - and charge these  
batteries across. Multiple  
are in series & discharge  
in multiple are (10) 450 volts  
would give 50<sup>or 500</sup> volts active  
on battery & touches main  
line for an instant &  
changes in tension. Commutator  
apparatus throws it in quantity  
the next instant & so on  
throws lamps on this is  
done several times a  
second. 1 apparatus is put  
in each house with meter  
which acts to disconnect all

there is sufficient charge<sup>35</sup>  
 but the instant it falls  
 below a definite amount  
 the rapid chgg & dischg  
 mechanism works, this  
 can also be done by a  
 venturist armature & mag  
 across the lamp chkt



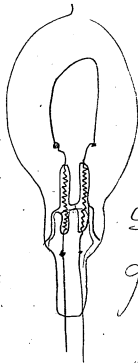
June 8 1862 T.A.S.





June 8 1882  
T.R.

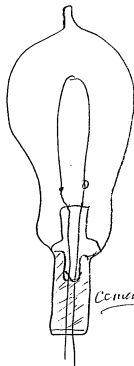




Caveat

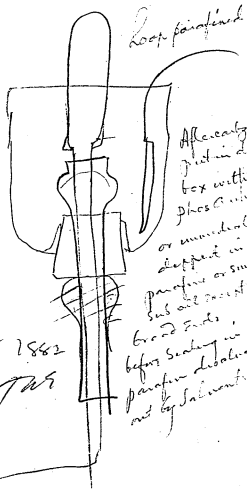
June 18 1882

7<sup>th</sup>  
fig 1 Caveat



Jan 18 1882  
JMS

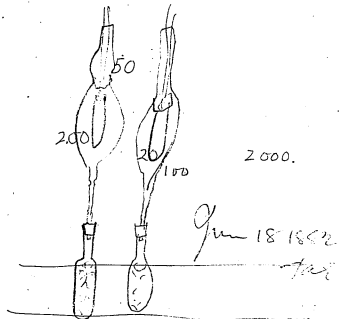
Coconut  
Cement



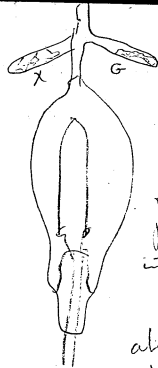
After casting  
put in dipping  
box with  
phos. & ...  
or immediately  
dipped in  
paraffin or similar  
Sub oil secret  
to red ends  
before sealing in  
paraffin dissolved  
out by solvent

June 18 1862  
TAR

57.



after sealing & drying  
to be kept with phos-  
ambly tube. an

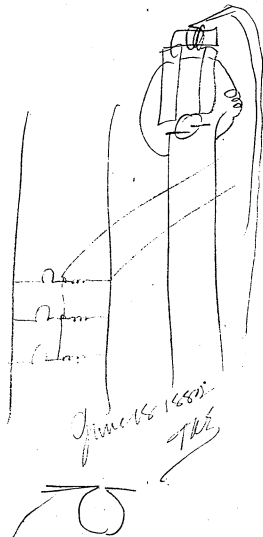


X phos anhyd  
G Charcoal  
made red +  
plunged under  
into chlorine gas.

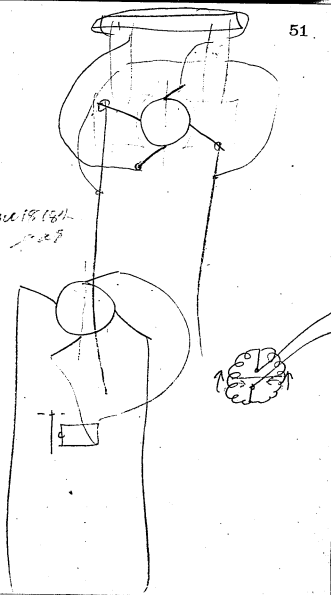
June 18 1882  
TAS

also hat +  
Kept in box  
with phos anhyd  
until put in  
lamp.

also Charcoal red  
hat. + put into  
vial of Chl Carbon

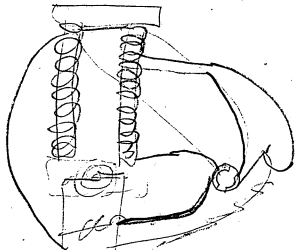


June 18 1881  
T.H.E.

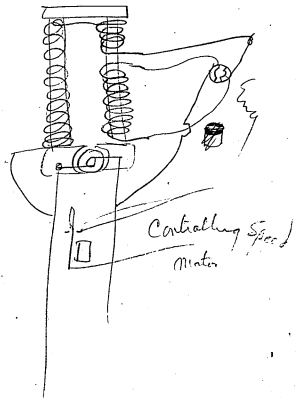


June 18 1881  
T.H.E.

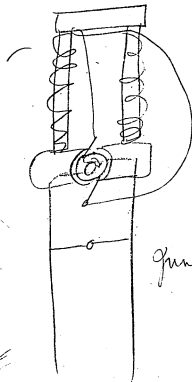
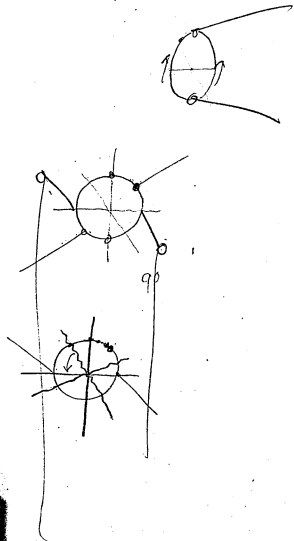
June 18 1882  
Th



using the Mag  
itself to make  
C. E. M. F.







June 1882  
TAE



$$\begin{array}{r}
 400 \\
 160000 \\
 \hline
 640000 \\
 640020 \\
 \hline
 1280020
 \end{array}$$

$$\begin{array}{r}
 25000 \\
 100000 \\
 \hline
 125000
 \end{array}$$

$$\begin{array}{r}
 300 \\
 400000 \\
 \hline
 120000
 \end{array}$$

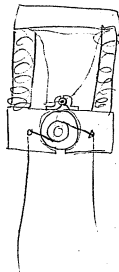
60

|         |      |
|---------|------|
| 100 000 | 280  |
| 50 000  | 560  |
| 25 000  | 1000 |
| 12      |      |

$$\begin{array}{r}
 280 \\
 3 \\
 \hline
 840
 \end{array}
 .24.$$

10

25.



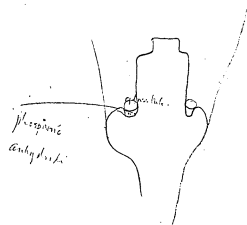
June 15 1892.

*[Signature]*

June 1876 -  
 Canine

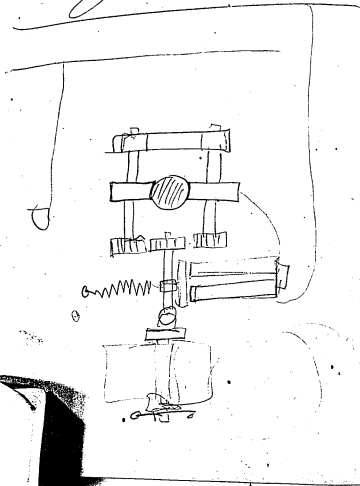
Proper color  
 organic material  
 treated over the  
 anhydrous stage

put in Lamp  
 about the 1st of  
 water: J. H. G.

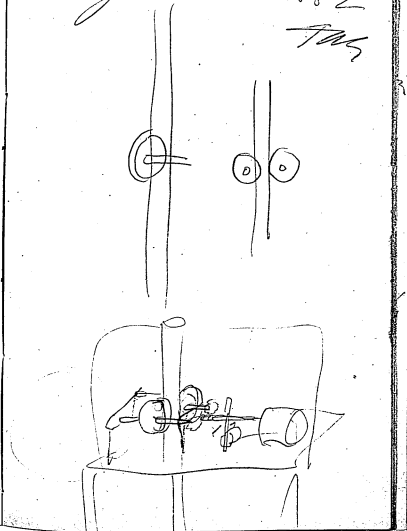




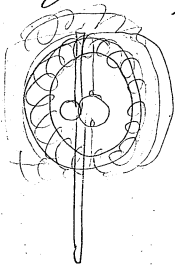
June 18, 1882  
Thu



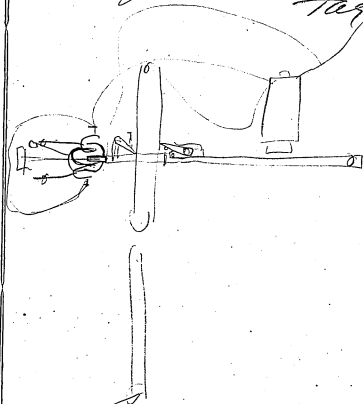
June 18, 1882  
Thu

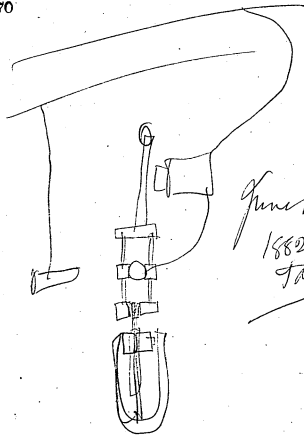


June 18/882  
G.H.



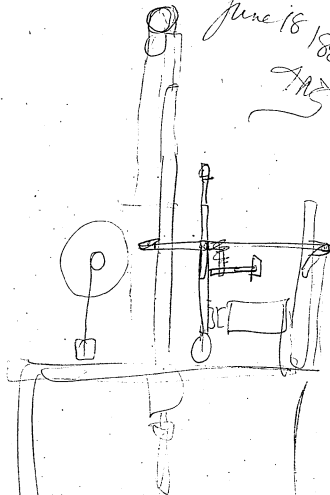
June 18/882  
G.H.



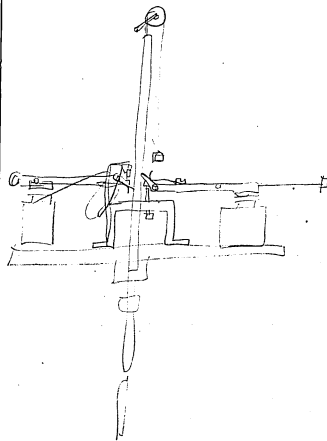
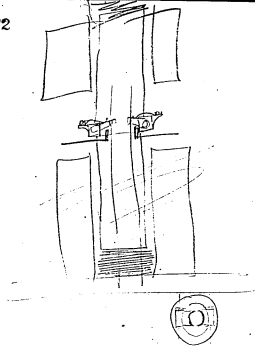


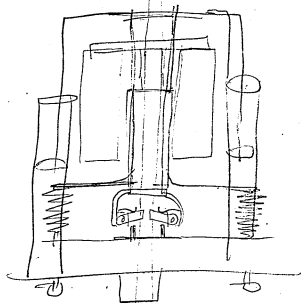
June 18  
1882  
JAZ

June 18 1882  
JAZ









## Caveat.

The object of this Caveat is to set forth  
various devices and inventions which  
I have patented for use in my system  
of Electric Lighting, but which require  
modification and arrangement for  
economical manufacture etc that  
they may be used commercially

= In Electric Lamps when a very  
high candle power is desired and the  
wire used the sealing in of the wire  
through the lamp should be very  
perfect I use a platinum leading in  
wire wound in the form of a spiral  
and both of the wires are sealed  
in tubes before final sealing to  
the inside part. See fig 1.

Straight Platinum wires coated  
with Tin Lead or other soft  
metal may be used. Even platinum

may be dispensed with and  
 nickel iron Copper ~~and~~ Silver  
 Cobalt, steel & other wires  
 may be coated with tin lead  
 or other soft metal & sealed  
 in the glass, the Expansion &  
 Contraction of the glass being  
 allowable as the soft metal  
 gives. In the case of platinum  
 lead ~~gives~~ combines with both  
 the glass and the platinum  
 & therefore makes a good seal.  
 The platinum may be coated  
 with an oxide of lead mixed with  
 anhydrous Oxide of sodium  
 and fused in the glass the  
 lead attacks the platinum &  
 the lead oxide. soda & glass  
 combines at the high  
 temperature to form glass.

thus making a perfect seal  
other metals as heretofore  
mentioned may be used instead  
of platinum.

finely divided platinum may be  
mixed with glass to such an  
extent as to cause the glass-  
platinum mixture to become  
of sufficient conductivity  
to be used as leading in wires  
in this case there is a  
perfect seal - When platinum  
alone or platinum-iridium  
alone is used for the leading  
in wires I prefer to put it  
through my process for  
freeing it of air & sealed  
in 1899 - I have made  
lamps in which in addition  
to the glass seal a cement

was poured into the inside part  
that was not in vacuum. This  
Cement is preferably a cement  
having no pores with vitious  
practice. Sealing wax & high  
boiling paints & tars &c. are  
useful. -

To keep water from being  
absorbed by the carbon  
filaments after carbonization  
I dip them when they are  
taken out of the mould in  
a solution containing a  
disinfectant & the membrane  
having no water paraffine  
disinfectant. ~~Being~~ a hydrocarbon  
liquid will cause the  
Carbon when dipped to be

Covered with a skin of  
 paraffin, Beeswax, resins,  
 gums Tar, etc may be used  
 all but the broad and Ends  
 are so dipped, afterwards the  
 Carbons are connected to the  
 leading wires & plated to  
 them electrically usually.  
 Then before the Carbons are  
 sealed in the ~~sealed~~ bulb of  
 the Lamp the paraffin or  
 other gum or substance is  
 well dissolved out by  
 immersing the loop in  
 a solvent of the substance  
 on the Carbon. The loop is  
 then sealed in the globe

and the top of the bulb has  
 along tube upon the end  
 on the end of this tube is a  
 piece of rubber tubing.  
 Small tubes closed at one  
 end are filled with a drying  
 agent such as Sulphuric or  
 Phosphoric anhydride -  
 Pentachloride ~~of Phosphorus~~  
 Chloride <sup>or</sup> ~~Sulphuric~~ <sup>or</sup> ~~other~~  
 drying agents. and this tube  
 is provided with a bevelled  
 mouth into which the rubber  
 of the tube on the lamp fits.  
 The lamps are kept with these  
 drying tubes on until ready  
 for exhaustion on the pump  
 when they are placed on a  
 revolving heater and heated



& then placed on the pumps <sup>89</sup>  
 a very rapid way of driving out  
 the moisture is to heat the  
~~lamp by the revalving heater~~  
 then place the bulb in connection  
 with an exhausting & forcing  
 pump the bulb remaining on  
 ice and exhausting the air  
 & then forcing fresh air into  
 the bulb which must pass  
 over a long tube filled with  
 phosphoric anhydride or other  
 drying agents. When the  
 moisture has been driven out  
 of the lamp it is placed on  
 the revalving heater and heated  
 very hot and then placed  
 on the pumps - In <sup>two</sup> a side  
 tubes connected to the Exhaust  
 tube of the Electric Lamp

one tube may have a drying  
 agent such as phosphoric anhydride  
 while the other may have  
 organic charcoal which  
 has been made red hot &  
 then allowed to cool for an  
 instant & plunged into  
 dry chlorine gas. the  
 charcoal absorbs chlorine.  
 It is then placed in the  
 tube, the bulb being  
 previously dried as mentioned.  
 the Camp is exhausted.  
 the Charcoal tube sealed  
 off at once or after a time  
 while the phosphoric anhydride  
 tubes may remain on for  
 a greater length of time.

of course in exhausting  
the lamp the fitment is  
at times brought to incandescence  
I will mention that ~~the~~ single tube  
might be used containing the  
drying agent & the chlorinated  
Charcoal, and it might be sealed  
off the lamp or kept in permanent  
connection therewith -

a small ball of charcoal  
filled with phosphorus <sup>anhydride</sup>  
or other drying agent might  
be used within the lamp.

The charcoal being impregnated  
with Chlorine, pure <sup>anhydrous</sup> alumina.

Silica in a finely divided state  
& pressed up into hollow cubes  
balls or other shapes might  
be filled with a drying

agent. Even paper & many other organic fibres ~~and~~ act as powerful drying agents & might be used.

95  
A good method of regulating the electromotive force of the lamp circuit also all, from the dynamo or rather in a generator's electric machine, is to use separate brushes on the commutator to work the field and so place these brushes that when the load increases by putting on lamp. The advantage will be taken of the shifting of the neutral point on the commutator due to load to give a greater electromotive force across these two brushes employed to give the field.

magnet as current, when the  
 two brushes are placed at  
 right angles to the brushes  
 that form the lamp circuit.  
~~It acts as a~~ the field from  
 the bridge wire of a Wheatstone  
 balance ~~to be~~ this is when  
 the load is very light hence  
 to obtain sufficient Emf.  
 To energize the <sup>lamp</sup> lamps that  
 are on the brushes must be set  
 off of the exact neutral point,  
 now if the load is increased  
 by adding lamps the neutral  
 point will shift & while  
 this causes the Emf of the

mainline brushes to drop  
 the EMF <sup>between</sup> ~~the~~ the field brushes  
 increases hence the drop in  
 EMF on one is nearly compensated  
 by the rise in the other due to  
 the action of the field magnet

Another method of regulating is  
 to use a small Electric Engine  
 for rotating brushes around  
 a Commutator & have this Commutator  
 connected to a portion only  
 of the core around the field  
 magnet this portion being more  
 or less rapidly reversed by  
 the rapidly revolving brushes  
 the Engine being controlled by  
 a magnet ~~as~~ ~~them~~ across

Multiple arc or by a thermostat  
 playing between two joints.  
 another device for regulating  
 the E.M.F. of a Dynamic machine  
 consists in interpolating in the  
 line a Resistance in the form  
 of several small wire multiples  
 or a sheet, and winding  
 this around a cylinder of  
 mercury with a long tube  
 extending therefrom into  
 which there a several platinum  
 wires connected to resistor  
 coils in the field of force  
 regulate the rise & fall of the  
 mercury column serving to  
 cut in & out more or less  
 resistance as more or less  
 lamps are put on

the mercury controller  
might be surrounded with  
very fine wire & the wire  
placed in multiple arc  
or it might receive its heat  
from an electric lamp  
radiating upon it such  
lamp being placed in  
multiple arc across the  
line,

another method of regulating  
the lamp circuit consists in  
using an extension from the polar  
field circuit & between which  
extension a small induction  
bobbin is rotated by a belt  
from the dynamo. this belt is  
shifted by an electric magnet



so I will either go down  
or fast the electromagnet  
being either in or across  
the line, thermostatic devices  
may also control it =  
this little bobbin is connected  
to the field of force coils &  
serves to energize them.

another form of governor consists  
of the driving pulley either  
on the machine or from a  
coupling shaft or even  
the engine being loose on the  
shaft and is connected  
to the shaft through the  
intermediary of a spring  
& lever which lever serves  
to throw resistance in.

and out of the ~~main~~ field  
 of force magnets. If but  
~~but~~ few lamps are on the circuit  
 the drag on the pulley is  
 light the spring is scarcely  
 depressed and all the  
 resistance is in. if now  
 the load is increased.  
 the spring will be depressed  
 and ~~more~~ resistance will  
 be cut out of circuit.

another device consists in  
 making a small portion of the  
 curved polar extension of  
 the field magnet detachable  
 & movable; have magnets  
 about  $\frac{1}{2}$  inch wide &  $\frac{1}{2}$  thick  
 from part of the polar piece.

and are connected together at the neutral point spring by brass. a lever is connected to the brass, ~~and~~ which leans moving in the direction of rotation of the dynamo. babbin cuts out resistance the tendency of the field or any part of it which is moveable is to move in the same direction as the rotating commutator and this tendency increases with the load hence the ring encircling the rotating babbin tends to rotate with the babbin in proportion to the load hence it becomes a very accurate device in connection

with resistance to regulation  
-the lamp by the field  
magnet.

If plates of zinc with lead  
between which are placed  
insulating material such as  
porous plates, and several  
pairs of these placed in a  
cell half of the plates  
being connected to one  
pole & the other half to the  
other pole, and the whole  
of the plates kept pressed  
together by a wedge  
Spring, gravitation or otherwise.

and a 20 percent solution  
 of sulphuric acid be used  
 and the liquid kept nearly  
 to the boiling point & the  
 battery while thus hot  
 is connected to a powerful  
 dynamo machine. Thick  
 coats of peroxide of lead  
 are formed rapidly all  
 homogeneous & integral  
 in electrical contact with  
 the electrode this coating  
 when once formed remains  
 integral the great object  
 in perfect storage batteries  
 always charging & discharging  
 the elements while they

are under pressure the  
more porous the pressure  
is the better.

Informing Carbons for electrodes  
light arcs. I use non volatile  
hydrocarbons such as the thickened  
Rubber like substances obtained  
from boiling the heavy oil.  
The Carbon finely powdered is  
mixed with the viscous drying  
oil either with or without asphalt<sup>if thin</sup>  
and well ground it in then  
dried and then put in a  
jamful press & forced  
anodes sticks. They are  
then baked & brought up to

a white heat then when  
 cool are placed in tubes  
 with a volatile hydrocarbon  
 or bitumen coil the tube  
 is closed and the whole  
 brought up to a white  
 heat the gases formed  
 enter into the pores of the  
 Carbon & deposit dense  
 Carbon thereon due to the  
 enormous high pressure in the  
 tube due to the gases themselves  
 Chloride of Carbon may be used  
 The tubes may be made so  
 strong that a liquid  
 hydrocarbons may be used  
 and be brought to a white

heat, extremely dense  
 Carbons are those obtained  
 which do not oxidize just  
 above the arc like ordinary  
 Carbons hence will last  
 ten or 15 times longer than  
 ordinary Carbons besides  
 they are better conductors of  
 Electricity.

When several filaments are placed  
 in series in one lamp sometimes  
 one of the filaments has a higher  
 resistance than the others in  
 this case a side tube being placed  
 on the exhausting tube &  
 containing chloride of carbon  
 the particular filament is brought  
 up to incandescence for an instant  
 to reduce its resistance by it



$$\begin{array}{r}
 300 \\
 100 \\
 \hline
 400 \\
 100 \\
 \hline
 500 \\
 100 \\
 \hline
 600 \\
 100 \\
 \hline
 700 \\
 100 \\
 \hline
 800 \\
 100 \\
 \hline
 900 \\
 100 \\
 \hline
 1000
 \end{array}$$

$$\begin{array}{r}
 325 \\
 325 \\
 \hline
 650 \\
 1056 \\
 \hline
 1625
 \end{array}$$

$$\begin{array}{r}
 975 \\
 1056 \\
 \hline
 2031 \\
 4225 \\
 \hline
 6256
 \end{array}$$

$$\begin{array}{r}
 185 \\
 525 \\
 \hline
 710
 \end{array}$$

$$\begin{array}{r}
 1600 \\
 4800
 \end{array}$$

$$\begin{array}{r}
 260 \\
 780
 \end{array}$$

800.

$$\begin{array}{r}
 15000 \\
 90000
 \end{array}$$

deposit of Carbon in it it is  
 then compared with the other  
 & when all give the same  
 light with the same voltage  
 they are permanently connected  
 in series and the lamp  
 sealed off at the pump -  
 another method is to hunt  
 the particular lamp by a  
 series fibre filament extension  
 to the lamp but a very  
 high resistance & through  
 which current passes  
 insufficient to bring it to  
 the oxidizing point this  
 resistance may be placed  
 in the base of the lamp

12

$$\begin{array}{r} 1200 \\ 10 \end{array}$$

$$\begin{array}{r} 12000 \\ 3 \end{array}$$

$$\begin{array}{r} 36000 \\ 300 \end{array}$$

$$\begin{array}{r} 10800000 \\ 16 \end{array}$$

$$\begin{array}{r} 64800000 \\ 10800000 \end{array}$$

$$\begin{array}{r} 172800000 \\ 86400 \end{array}$$

2000



8.000 000

$$\begin{array}{r} 10000000 \\ 33 \end{array}$$

$$\begin{array}{r} 30000000 \\ 30000000 \\ 33000000 \end{array}$$

330000

750,000

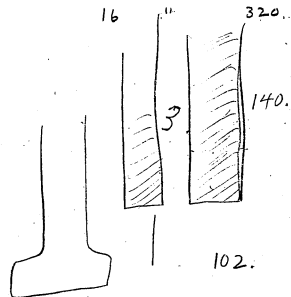
330.000 Ms.

86.400 Ms. 90.

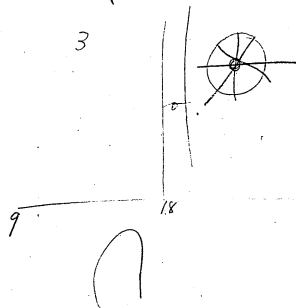


16. Candles. 140. shms  
90,000.

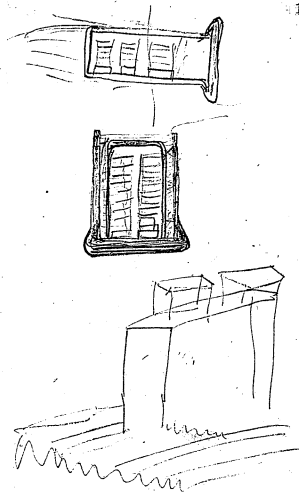
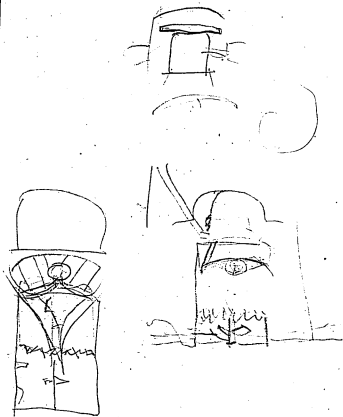
16 11 320 40,000.

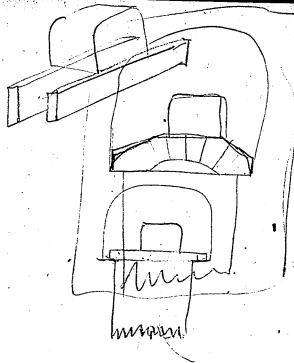
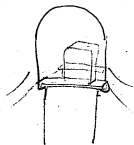


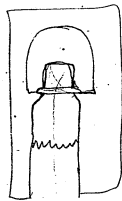
16~



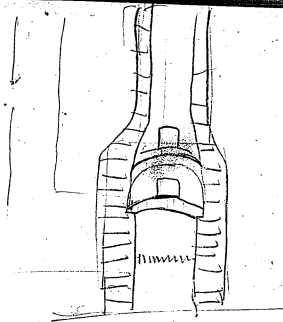
10. 320.







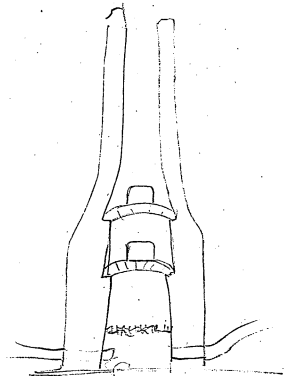




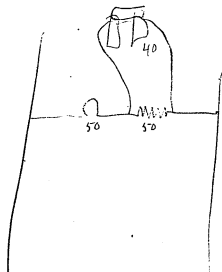
154



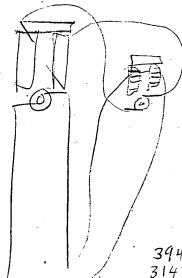
155







$$180 \left| \begin{array}{r} 551930 \\ 540 \\ \hline 19 \end{array} \right| 3$$



$$\begin{array}{r} 3942 \\ 3142 \\ \hline 800 \end{array}$$

$$140 \left| \begin{array}{r} 440000 \\ 4200 \\ 200 \\ 140 \\ 600 \\ 100 \\ 120 \end{array} \right| 3142$$

$$\begin{array}{r} 112 \\ 112 \\ \hline 224 \\ 112 \\ \hline 112 \\ 12544 \end{array}$$

$$140 \left| \begin{array}{r} 50170 \\ 50176 \\ \hline 551930 \\ 4200 \\ 1360 \\ \hline 5680 \end{array} \right| 3942$$

$$\begin{array}{r}
 175 \overline{) 3153} \quad 18 \\
 \underline{175} \phantom{00} \\
 1403 \\
 \underline{1400} \\
 178
 \end{array}$$

$$\begin{array}{r}
 35 \\
 18 \\
 \hline
 280 \\
 35 \\
 \hline
 63
 \end{array}$$

$$\begin{array}{r}
 175 \overline{) 551930} \quad 3153 \\
 \underline{525} \phantom{00} \\
 269 \\
 \underline{175} \phantom{00} \\
 943
 \end{array}$$

$$\begin{array}{r}
 140 \overline{) 3153} \quad 22 \\
 \underline{280} \phantom{00} \\
 353 \\
 \underline{280} \\
 73
 \end{array}$$

$$\begin{array}{r}
 22 \overline{) 500} \quad 35 \\
 \underline{44} \phantom{00} \\
 60 \\
 \underline{55} \\
 5
 \end{array}$$

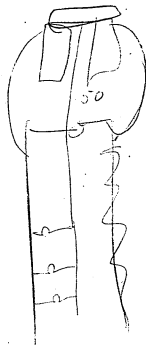
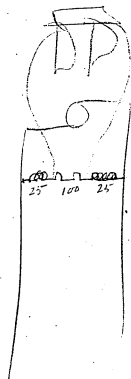
$$\begin{array}{r}
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 \underline{875} \\
 680 \\
 \underline{525} \\
 155
 \end{array}$$

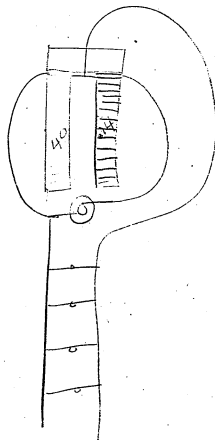
$$\begin{array}{r}
 3150
 \end{array}$$

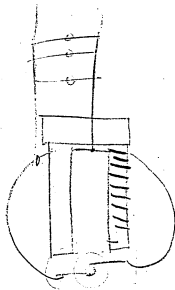
$$\begin{array}{r}
 22 \\
 35 \\
 \hline
 70 \\
 70 \\
 \hline
 77
 \end{array}$$

$$\begin{array}{r}
 35 \\
 22 \\
 \hline
 70 \\
 70 \\
 \hline
 77
 \end{array}$$

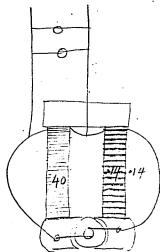
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 \underline{350} \phantom{00} \\
 442 \\
 \underline{350} \\
 92
 \end{array}$$









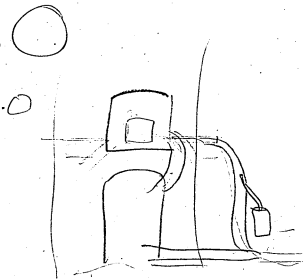
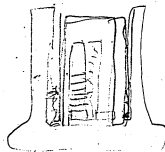
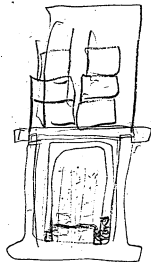


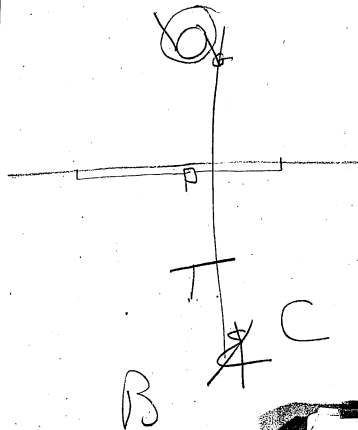
John Ott to try  
and Roland to know

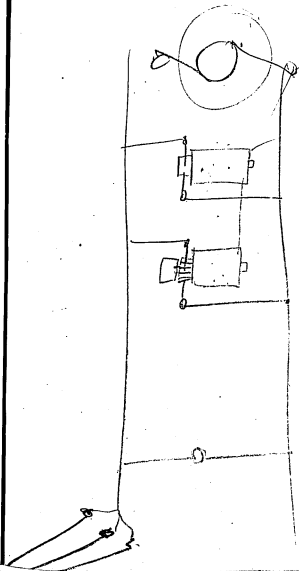
Aug 18 1912  
J. H. Ott

Deposit Carbon from pure  $\text{CO}$  or  
 $\text{CO}_2$  see if pure  $\text{O}$  attracts  
Carbon Aug 15 1882

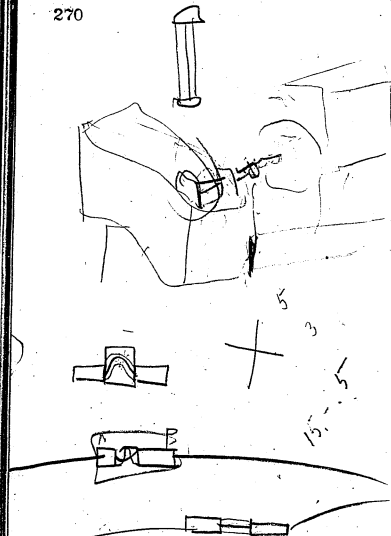
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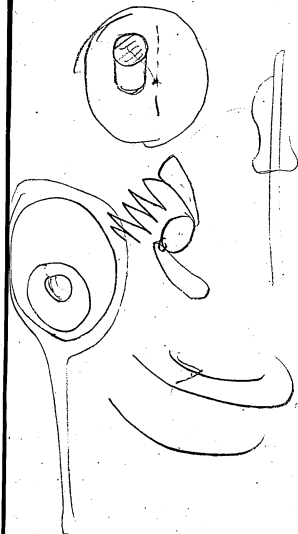


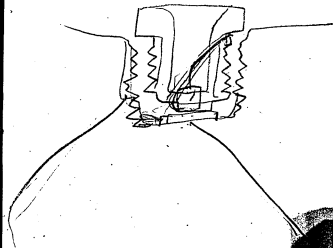


270



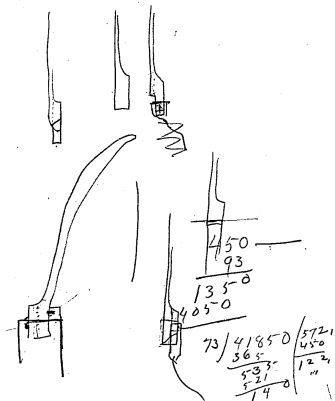
271





Mercury Crooke Motor.  
 Rubber expansion motor.  
 Photogr. Scintillation, with Crooke's bulb  
 whole Leyden + Big Coil + with Crooke's  
 + battery or dynamo.





$$\begin{array}{r}
 125 \\
 75 \\
 40 \overline{) 500000} \\
 \underline{35}
 \end{array}$$

$$\begin{array}{r}
 125 \\
 100 \\
 75 \\
 40 \overline{) 3000} \\
 \underline{200} \\
 1000 \\
 \underline{800} \\
 200 \\
 75 \overline{) 1000} \\
 \underline{750} \\
 250 \\
 \underline{250} \\
 0
 \end{array}$$

Menlo Park Notebook #198 [N-82-05-10]

This notebook covers the period May-June 1882. All of the entries are by Edison and consist of notes and drawings relating to iron ore separation, thermoelectricity experiments, the electric railroad, electric lighting, and storage batteries. The book contains 278 numbered pages.

Blank pages not filmed: 26, 43-49, 76-77, 82-83, 86-101, 104-109, 112-153, 156-273.

Missing page numbers: 27-42.

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BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

*From Library*  
*at New York*

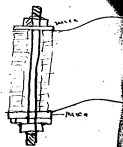
May 1, 1895

May 10 1882.

1

Experimenting on reducing iron sand  
to iron also mixing with Coke, charcoal, etc  
& tar, Gouda Pet. Mould in briq and heating  
sufficiently to consolidate,

Thermo Experiments



discs of Cu & Gen Sil  
alternated. heating one  
end causes heat travel to other end  
and there is a gradual fall of heat  
until the other end is scarcely  
hotter than the atmosphere..  
by using several thousands of  
these discs an exceedingly  
novel & economical conversion  
of heat into Elect is obtained

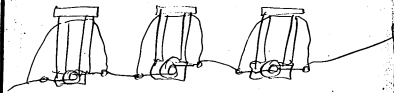
May 10 1882

I am plating Copper sheet with 3  
 German Silver also other  
 sheets of Copper with nickel.  
 Alternately. first Copper then  
 exceedingly thin Co at nickel then  
 Copper then nickel & so on  
 until several hundred  
 thicknesses is obtained the  
 sheet is then cut out in  
 circular holes drilled in  
 centre & all the several discs  
 gathered together forming  
 thin pile,

Today we run the Electric  
 Railway with 3 machines  
 in series. Each working its  
 own field independent  
 of the other as shown  
 on next page

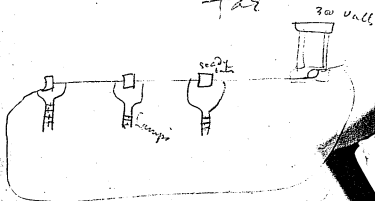
May 10 1882 TAE

Johns F.M. 5

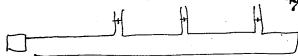
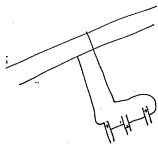


May 10 1882

TAE

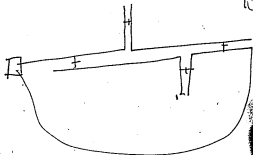
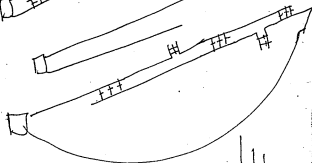


Reduce pressure by Sec'dy  
batteries. no consumption.

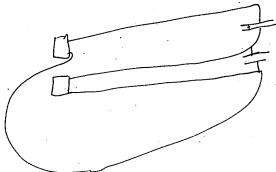
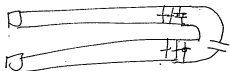


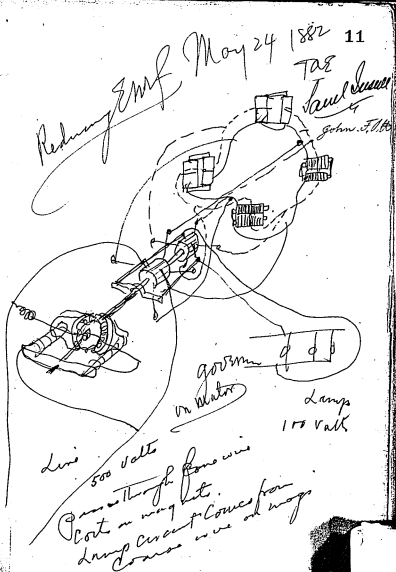
May 24 1882 T.C.S.

John. H. H.



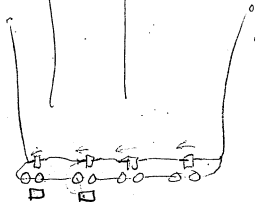
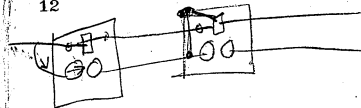
May 24 1942  
Tal



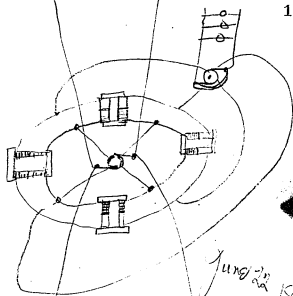




12



13



June 22 1892

Aug  
Chas. D. Young  
John W. (St.)

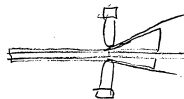
Reduction Exp.  
Cath pair brushes  
Groove type simulators and  
together the main line  
Coils are of fine wire &  
500 to 1000 volts used  
while the local coils of  
large wire are 100 volts used.



New Method preparing  
Lead plates for storage  
consists of facing a lead  
plate with an alloy of  
lead & Zinc. Immerse  
in  $\text{SO}_3$  & put battery on  
with paper between  
plates under pressure.  
after preparation the  
plates are taken out &  
put in fresh cell with  
 $\text{SO}_3 + \text{H}_2\text{O}$ . ready for use  
in future -

JUNE 22 1882

gar  
Chas. F. K. H. S.  
John F. H.



60.

$$\begin{array}{r} 600 \\ 90 \\ \hline 54000 \end{array}$$

$$\begin{array}{r} 270000 \\ \hline \end{array}$$

$$\begin{array}{r} 400. \\ 30 \\ \hline 12000. \\ 15 \end{array}$$

$$\begin{array}{r} 12000 \\ 3 \\ \hline \end{array}$$

$$\begin{array}{r} 36000 \\ \hline \end{array}$$

$$\begin{array}{r} 108000 \\ \hline \end{array}$$

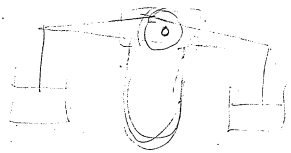
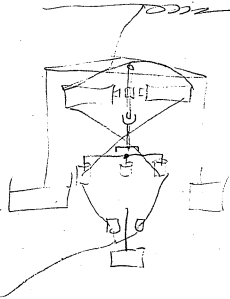
$$\begin{array}{r} 36000 \\ 30 \\ \hline \end{array}$$

$$\begin{array}{r} 1080000 \\ \hline \end{array}$$

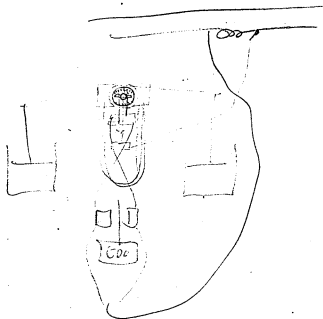
270.

3

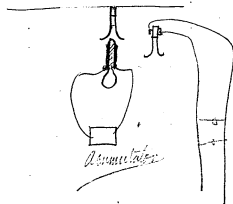
$$\begin{array}{r} 400. \\ 32 \\ \hline 64 \overline{) 100000} \quad 15 \\ \underline{6400} \\ 36000 \\ \underline{32000} \end{array}$$



June 23 1892  
John F. Otto. T.M.



June 23 1882  
— 702  
John F. H.

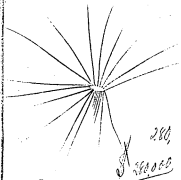


Post and Company

Company  
*[Signature]*

Directors  
 T. E. Brown  
 J. E. Brown  
 Warrington  
 Warrington  
 James  
 Conway





|          |      |   |
|----------|------|---|
| Fabrizi  | 2500 |   |
| Wright   | 2500 |   |
| Adams    | 2500 |   |
| P Morgan | 2500 |   |
| Eaton    | 1000 |   |
| ENY      | 3000 |   |
| Batch    | 3000 | 5 |
| Edison   | 5000 |   |
| Bergmann | 1000 |   |
| Upton    | 3000 |   |

5000

$$\begin{array}{r} 25 \\ 10 \\ \hline 25-0 \end{array} 10$$





$$\begin{array}{r} 600 \overline{) 6075.00} \\ \underline{1012} \phantom{00} \\ 6073.00 \\ \underline{6073.00} \end{array}$$

$$\begin{array}{r} 1012 \\ \underline{50} \\ 0 \end{array}$$

$$\begin{array}{r} 35 \\ \underline{25} \\ 175 \\ \underline{70} \\ 873 \end{array}$$

$$\begin{array}{r} 1012 \\ \underline{600} \\ 60800 \end{array}$$

$$\begin{array}{r} 225 \\ \underline{673} \\ 202300 \\ \underline{607500} \\ 600 \overline{) 6075.00} \end{array}$$

$$\begin{array}{r} 24 \overline{) 112} \quad 4.6 \\ \underline{96} \\ 160 \end{array}$$

$$\begin{array}{r} 225 \\ \underline{3} \\ 675 \\ \underline{300} \\ 302500 \end{array}$$

$$\begin{array}{r} 5 \overline{) 225} \\ \underline{45} \\ 4 \\ \underline{700} \end{array}$$

$$\begin{array}{r} 305 \\ \underline{250} \end{array}$$

$$\begin{array}{r} 202500 \\ \underline{607500} \\ 607500 \\ \underline{607500} \\ 0 \end{array}$$

350

40

~~250 lights~~

225-400 at max

Est

|                       |       |
|-----------------------|-------|
| 1 Dynamo              | 1350  |
| 1 Extra armature      | 375-  |
| 1 Engine              | 750-  |
| 1 Boiler              | 875-  |
| 1 Radiator            | 25-   |
| 1 Indicator           | 25-   |
| 1 Photometer          | 12-   |
| 2 Belts               | 25-   |
| Station               | 500   |
| Foundation setting    | } 300 |
| Installation          |       |
| Meters 34             | 50    |
| Scale                 |       |
| Extra plates Solution | 20    |
| Etc                   |       |
| Oil cans waste etc    | 10    |
| Smoke stack           | 30    |
| Poles. 50 poles       | 375-  |
| Setting               | 125-  |
| Stringing wire        | 200   |
| Wire                  |       |
| Insulators            | 90    |
| Running 3 Houses and  |       |
| Foundations etc.      | 150   |
| Running expenses      |       |
| Lamps                 | 500   |
| Engineer              | 1000  |
| Meter Bookkeeper      | 800   |
| Outside labor         |       |
| Coal 3 hours daily    | 300   |
| 225 lights            | 250   |
| 5 400 lbs             |       |
| 5 400 lbs             |       |

5 miles  
poles

~~200~~ group lights  
only 450 used at maximum

|                              |                    |
|------------------------------|--------------------|
| 2 dynamos                    | 2700               |
| 1 Extra Armature             | 375                |
| 2 Engines                    | 1580               |
| 1 Piping                     | 175                |
| 1 Blower                     | 1600               |
| 1 Regulator                  | 25                 |
| 1 Indicator                  | 25                 |
| 1 Phonometer                 | 10                 |
| 3 lights                     | 37                 |
| Slates                       | 500                |
| Foundations Setting          | 450                |
| Installing                   | <del>1000</del>    |
| Smoker Stack                 | 500                |
| Wheels                       | <del>225</del> 320 |
| Scale                        | 50                 |
| Exhaust plain insulation etc | 25                 |
| Oil cans waste etc           | 10                 |

Pales. Setting stringing  
wire -

Wire.

Insulation

Running to Houses

Running by

Lamps

Engs

Boys

Outside near Miller etc

800 lbs Coal per night

Oil waste engs & lamps

1000

1000

300

900

500

500

140.

16 320

$$\begin{array}{r}
 675 \\
 3375 \\
 \hline
 5-675 \\
 135 \\
 20 \\
 \hline
 2700
 \end{array}$$

3

~~715 light~~  
675 used at max 59

|                              |                    |
|------------------------------|--------------------|
| 3 Dynamoes                   | 4050               |
| 1 extra armature             | 875                |
| 3 Engines                    | 2250               |
| 1 Boiler                     | 2700               |
| Regulation                   | 200                |
| 4 Belts                      | 30                 |
| Plate on                     | 500                |
| foundations Setting Install. | 800                |
| Utrole                       | 75                 |
| Meters                       | <del>325</del> 500 |
| Scale - for plates etc       | 85                 |
| Oil Cans Waste Etc           | 15                 |

Pales. Setting. stringing wire  
11 mi.  
Insulation  
Running wire to house.

|                              |      |
|------------------------------|------|
| Lamps                        | 1500 |
| Ex. fr                       | 1000 |
| Extra man.                   | 450  |
| Outside man Meters books etc | 1000 |
| 1200 lbs coal - 3 hours run  | 900  |
| Oil Waste Repairs Supplies   | 750  |

1305.0

$$\begin{array}{r} 200 \\ 75 \\ 950 \\ \hline 675.00 \\ 337.00 \end{array}$$

33

$$\begin{array}{r} 65 \\ 300 \\ \hline 795.00 \\ 65.00 \\ \hline 1360.00 \end{array}$$
~~1000~~ lights -  
900 Maximum

|                               |      |
|-------------------------------|------|
| 4 Dynamos                     | 5400 |
| <del>4</del> 4 armature       | 375  |
| 4 Engines                     | 3000 |
| 1 Boiler                      | 3000 |
| Regulation                    | 250  |
| 6 Belts                       | 75   |
| Station                       | 500  |
| Foundation setting Installing | 800  |
|                               | 100  |
| Waste                         |      |
| Meters                        | 800  |
| Scale etc plates etc          | 125  |
| Oil cans etc                  | 25   |

Only setting stringing wire  
wire  
Insulators  
Running to house

|                  |      |
|------------------|------|
| Lamps            | 2000 |
| Engs             | 1000 |
| Extra man        | 450  |
| General man      | 1000 |
| Coal             | 1250 |
| Repairs Supplies | 1000 |

$$\begin{array}{r} 200 \\ 15 \\ \hline 00 \end{array}$$

$$\begin{array}{r} 1500 \\ 2 \\ \hline 3000 \end{array}$$
1250

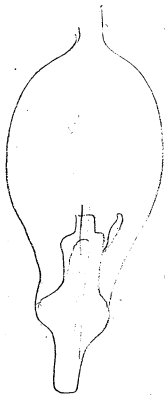
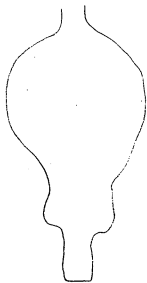
1125 Maximum

|                           |       |
|---------------------------|-------|
| 5 Lamps                   | 6750  |
| 2 Galla annulata          | 750   |
| 2 Large Enclosures        | 24000 |
| 1 Small Cell              | 750   |
| 1 Beetle                  | 3500  |
| 1 pupa                    | 80    |
| 1 pupation                | 150   |
| 7 Belts                   | 650   |
| Salmon                    |       |
| Foundation Setting Insula | 1200  |
| Stable                    | 150   |
| Miters                    | 1600  |
| Scale Epidemics Etc       | 160   |
| Oil Cans                  | 35    |

Notes Setting Shrimps etc  
1000

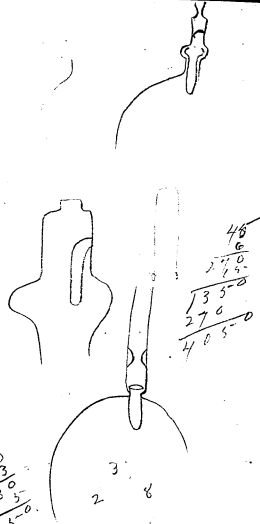
Incubation  
Furnishing wood to houses

|                  |      |
|------------------|------|
| Lamps            | 2500 |
| Energy           | 1200 |
| Extra material   | 500  |
| General material | 1300 |
| Coal             | 1600 |
| Repairs etc      | 1300 |



11980  
27<sup>u</sup>  
12.25.4

$$\begin{array}{r}
 310 \\
 \underline{3} \\
 930 \\
 \underline{935} \\
 465-0
 \end{array}$$



$$\begin{array}{r}
 46 \\
 \underline{6} \\
 270 \\
 \underline{135-0} \\
 270 \\
 \underline{405-0}
 \end{array}$$

3  
2 8

1500 freight

1350 maximum

|                          |      |
|--------------------------|------|
| Edna pillow box          | 180  |
| 1 40 lbs switch          | 8100 |
| 6 dynamometers           | 750  |
| 2 9th ammeter            |      |
| 3 large engines          | 3600 |
| 1 boiler                 | 4200 |
| Regltn                   | 125  |
| 8 Belts                  | 225  |
| Station                  | 800  |
| Formulations Setting etc | 1600 |
| Stroke                   | 200  |
| Mileage                  | 1300 |
| Scale Edna plate & to    | 200  |
| oil cans etc             | 50   |

Palis Setting & hanging iron.  
Insulator  
Running to House

|                      |      |
|----------------------|------|
| Engine               | 3000 |
| Edna man             | 1300 |
| General man & boy    | 525  |
| Coal                 | 1450 |
| Repairs Supplies etc | 2100 |
|                      | 1700 |



$$\begin{array}{r}
 90 \\
 80 \\
 \hline
 170 \\
 15 \\
 \hline
 185 \\
 225-0 \\
 \hline
 450 \\
 675-0 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 45 \\
 7 \\
 \hline
 315 \\
 15 \\
 \hline
 330 \\
 15 \\
 \hline
 345 \\
 472-5 \\
 \hline
 \end{array}$$

1750 Lights  
1575 maximum -

|                          |      |
|--------------------------|------|
| 7 Dynamoes               | 9450 |
| 2 Extra armature         | 750  |
| Extra pulley blocks etc. | 250  |
| 3 Large 1 Small Engine   | 4350 |
| 1 Pulley                 | 450  |
| 1 Roller                 | 200  |
| Population               | 275  |
| 10 belts                 | 1000 |
| Station                  | 1900 |
| Foundation setting       | 275  |
| Sticks                   | 1600 |
| Misc.                    | 300  |
| Boiler parts etc.        |      |

|                                      |      |
|--------------------------------------|------|
| Lamps                                | 3500 |
| Engs                                 | 1300 |
| auxt Engs                            | 750  |
| Foundry                              | 500  |
| General man boy                      | 1500 |
| <del>Boiler parts</del> outside work | 500  |
| Coal                                 | 250  |
| Repairs Supplies etc.                | 2300 |

$$\begin{array}{r}
 25.00 \\
 \underline{3} \\
 75.00 \\
 \underline{3} \\
 225.00 \\
 \underline{300} \\
 6-151.00 \\
 \underline{112.50} \\
 225.00 \\
 \underline{12} \\
 45.00 \\
 \underline{225.00} \\
 270
 \end{array}$$

1125-

$$\begin{array}{r}
 1350 \\
 \underline{12} \\
 2700 \\
 \underline{1350} \\
 162
 \end{array}$$

$$\begin{array}{r}
 12 \\
 \underline{45} \\
 60 \\
 \underline{48} \\
 5.45 \\
 \underline{2700}
 \end{array}$$

$$\begin{array}{r}
 12 \\
 \underline{3} \\
 3600
 \end{array}$$

2000 Right  
2000 Max

|                         |       |
|-------------------------|-------|
| 10 Dynamos              | 13500 |
| 12 galvanometers        | 2700  |
| 5 large Engines         | 6000  |
| galvanometers           | 250   |
| 2 Bells                 | 6750  |
| Regulation              | 350   |
| 12 Bells                | 350   |
| Station                 | 1400  |
| Foundation setting etc. | 2500  |
| Stax                    | 350   |
| Meters                  | 2000  |
| Scales etc.             | 400   |

|                    |      |
|--------------------|------|
| Lamps              | 4500 |
| Engines            | 200  |
| Asst Engs          | 500  |
| Fireman's vest     | 800  |
| General man vest   | 1700 |
| Overalls man       | 750  |
| Coal               | 3400 |
| Repairs & supplies | 2500 |

3600  
5100  
5150  
2000  
7205

1350  
6  
8100



45-  
12  
90  
45-0  
545-

270  
540  
810

371

3  
1125

31300

2500  
75  
12500  
17500  
1874  
93

93  
786300  
558300  
18500  
37300

## 2500 Lights

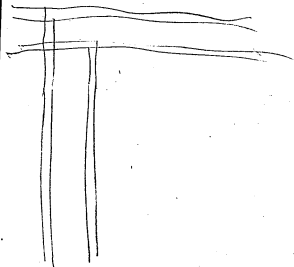
|                    |       |
|--------------------|-------|
| Switches           | 1500  |
| 12 lamps           | 16200 |
| pellets            | 300   |
| 6 large lamps      | 7200  |
| Parting lamp parts | 300   |
| Boilers            | 8500  |
| Pipes              | 200   |
| Regulation chimney | 450   |
| 15 belts           | 425-  |
| Slater             | 1700  |
| Foundation salt    | 3200  |
| Stack              | 450   |
| Meters             | 2500  |
| Scales etc         | 525-  |

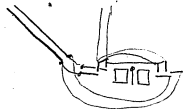
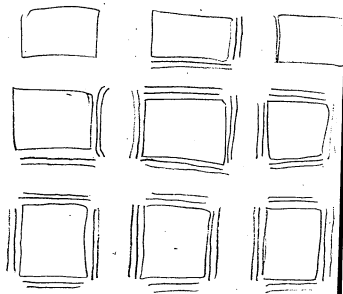
|                        |      |
|------------------------|------|
| Lamps                  | 5700 |
| Engs                   | 1400 |
| Coal Eng               | 900  |
| Fireman's coat         | 1000 |
| General work coat      | 1700 |
| Coal                   | 800  |
| Coal                   | 3800 |
| Extras Repair Supplies | 3200 |

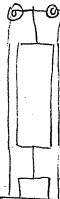
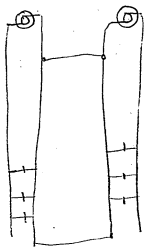
74

3000 lights

75







65.1

40.  $2\frac{1}{2}$   $1\frac{1}{7}$ .

$$\begin{array}{r}
 8. \\
 10.5- \\
 .35- \\
 75- \\
 20 \\
 \hline
 10.55,
 \end{array}$$

5250

550  
10

4.

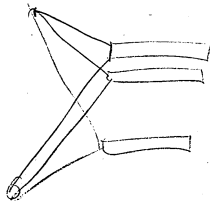
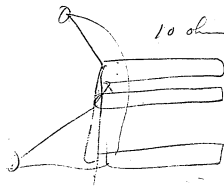
$$\begin{array}{r}
 5250 \\
 26400 \\
 10560 \\
 \hline
 7500
 \end{array}$$

7500

5550.

$$\begin{array}{r}
 3050 \\
 10560 \\
 \hline
 13610
 \end{array}$$





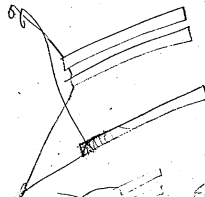
$$\begin{array}{r}
 17 \overline{) 1760000} \\
 \underline{1760000} \\
 0 \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000
 \end{array}$$

103: 26760000

$$\begin{array}{r}
 17 \overline{) 1760000} \\
 \underline{1760000} \\
 0 \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000
 \end{array}$$

8: 7040000

88000



$$\begin{array}{r}
 17 \overline{) 1760000} \\
 \underline{1760000} \\
 0 \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000 \\
 \underline{000000} \\
 000000
 \end{array}$$

33170

10

20.

$$\begin{array}{r}
 60 \\
 8 \\
 \hline
 10 \text{ Vahen } 580.
 \end{array}$$

$$\begin{array}{r}
 60 \overline{) 5280} \\
 \underline{4200} \\
 1080 \\
 \underline{1080} \\
 0
 \end{array}$$

704

$$\begin{array}{r}
 704 \\
 65 \\
 \hline
 422.4
 \end{array}$$

c "Chosen illuminative Souls of the  
world"

E = Dictating his intellect"

60

$$\begin{array}{r} 50 \\ 100 \\ \hline 5000. \end{array}$$

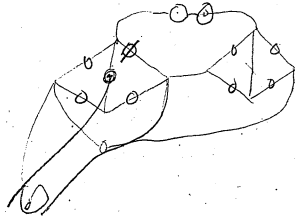
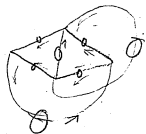
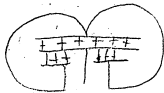
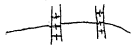
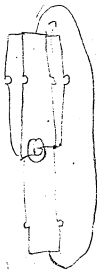
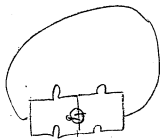
8

64

$$\begin{array}{r} 300 \\ 20 \\ \hline 12 \overline{) 6000} \end{array} \begin{array}{r} 12 \\ 500 \\ \hline 6000 \end{array}$$

$$\begin{array}{r} 850 \\ 850 \\ \hline 425-00 \\ 6800 \\ \hline 7225-00 \end{array} \begin{array}{r} 5000 \\ 500 \\ \hline 2500000 \end{array} \begin{array}{r} 76 \\ 231 \\ 190 \\ \hline 198 \end{array}$$

76.



**Menlo Park Notebook #201 [N-81-05-21]**

This notebook covers the period May 1881. All of the entries are by Edison and consist of notes and drawings relating to dynamos and arc lights. The book contains 280 numbered pages.

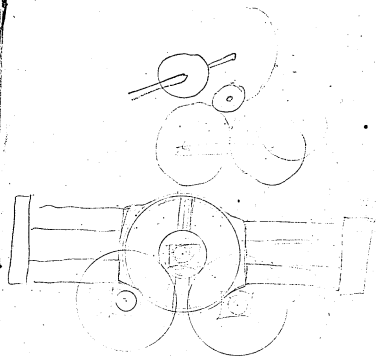
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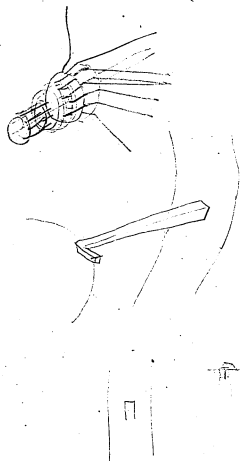
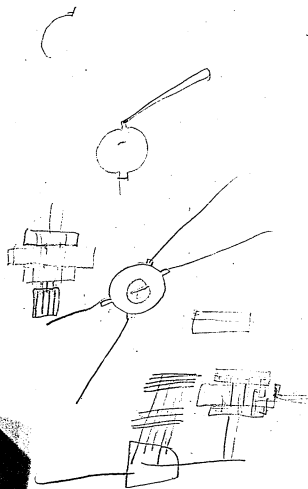
LIBRARY OF THE  
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

*From Library*  
GENERAL INVESTIGATING  
112 Broad St. N.Y.

*May 1*, 1896







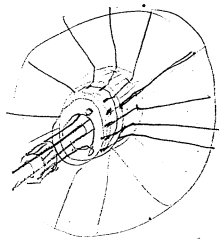
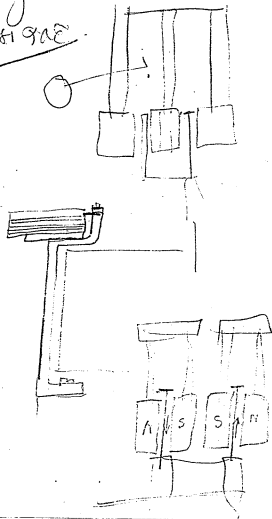
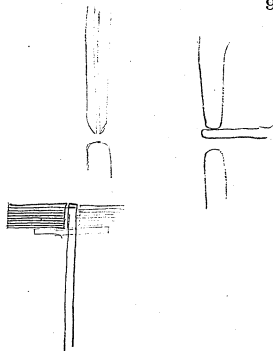
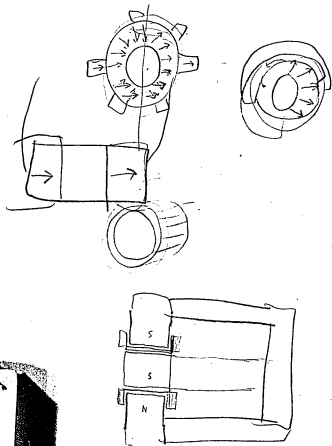


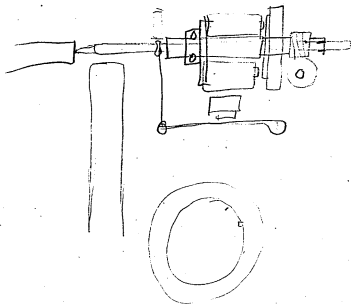
Plate Dyakno —  
 May 24 1861 GAE.

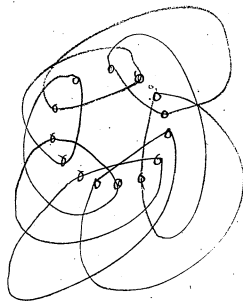


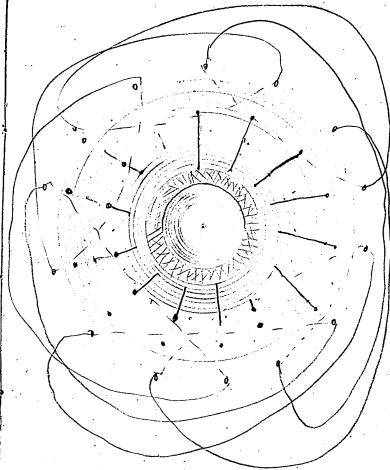


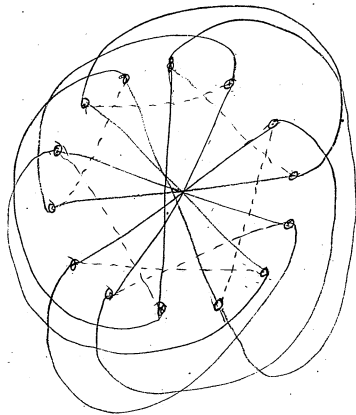


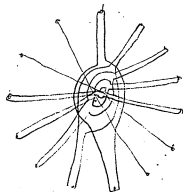
Arc Light = May 24 1881  
 JAE



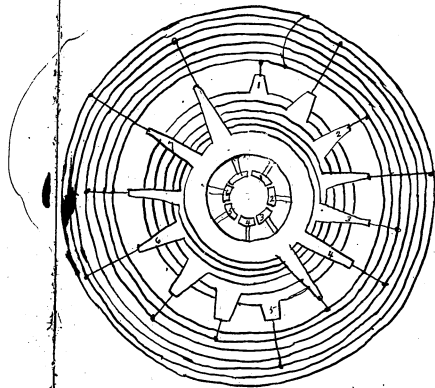




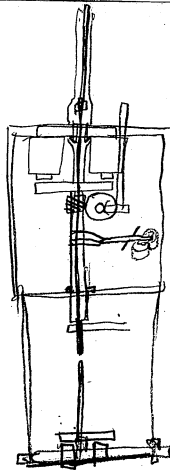




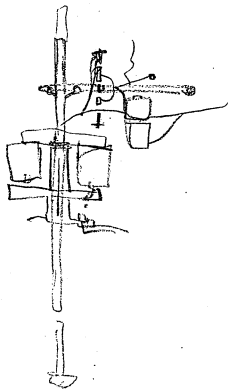




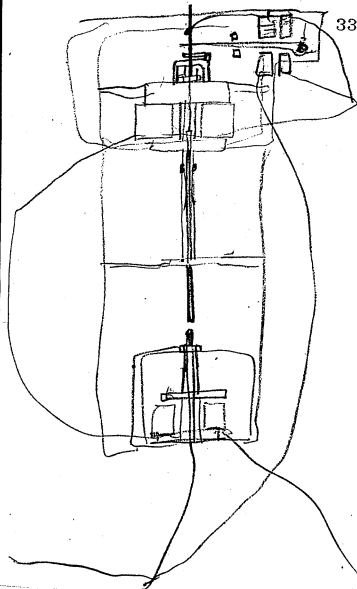
Matthew White  
May 21 1881  
JAG

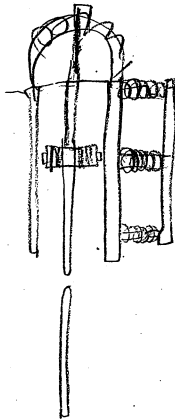


32



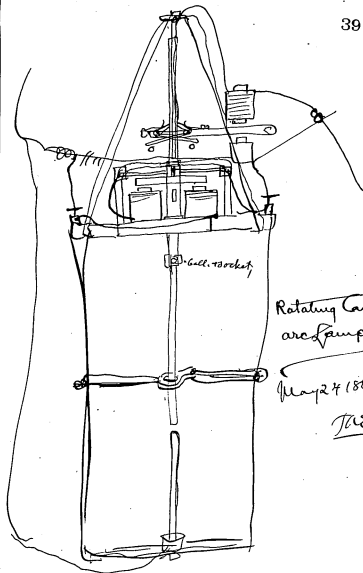
33





7.11.1

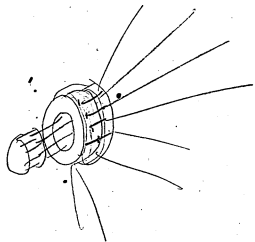




Rotating Carbon  
arc lamp

May 24 1881

TAE



Menlo Park Notebook #203 [N-82-05-15]

This notebook covers the periods May-December 1882 and July-October 1884. The entries are by Edison, Martin N. Force, and John Ott. Most of the entries are notes and drawings relating to storage battery experiments, including a set of notes by Edison on the direct production of electricity from carbon in batteries. There are also notes and drawings of filament experiments, notes on insulating commutator brushes with plaster of paris, notes and drawings of telephone experiments, and notes on an electric light plant in New York. The label on the front cover is marked "Menlo Park" and "M N F." The book contains 278 numbered pages.

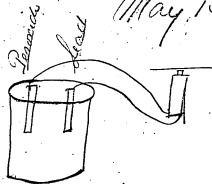
Blank pages not filmed: 82-103, 136-137, 184-185, 218-271, 274-277.



X E-172

N-82-05-15

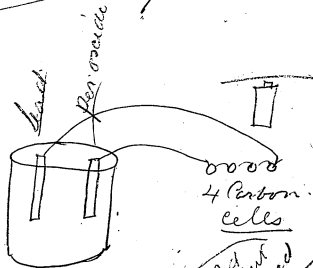
May 13<sup>1</sup> 1882



Dissolution of  
Bismuth acetate  
Lead in to of  
water

Tried this  
experiment.  
Lanson did not  
state the results

May 15 1882



10 pct. Sul Acid  
100 water  
both plates  
per. oxide lead.

This worked  
very well, but  
soon polarized

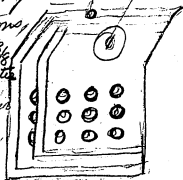
May 16 1882

Took two lead plates  
perforated, ~~with~~ filled  
one plate, with finely  
divided <sup>metals</sup> lead made in  
the chemical laboratory.  
The other plate was filled  
with per-oxide, lead, not pressed.

This worked well, without  
any charge, being a battery  
in its self

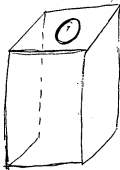
May 17<sup>th</sup> 1882<sup>7</sup>

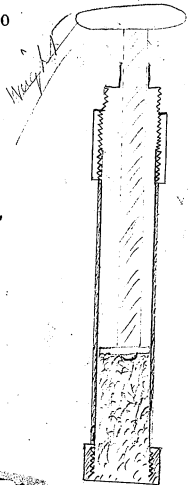
Took two lead plates  
 Perforated, filled one plate  
 with peroxide  
 of lead pressed  
 in buttons,  
 about  $\frac{3}{8}$   
 in diameter  
 The other  
 plate  
 was  
 filled



May 18 1882 9

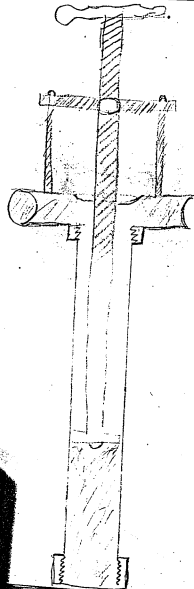
Made two moulds of  
charcoal for Mr Edison  
to try an experiment  
with, like this





May 19 1882 11

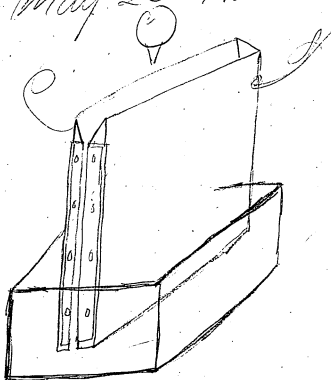
Tried an experiment  
on Carbon-Tank. some  
Bituminous coal and  
powdered it finely, then  
put it in a tube made  
of  $\frac{1}{4}$  inch iron pipe  
made a plunger to fit  
the inside of the pipe, and  
then put in the furnace  
with a heavy weight on  
the plunger, brought it  
up to a light red,



May 20 1889

Tried ~~an~~ experiment on carbon  
but instead of putting the  
pressure on by a weight  
I done it by a screw  
So I changed ~~the~~ it and  
made it like the sketch

May 23 1882





May 30 1882 Tue 17

Experiments in crucibles  
with fused substances &  
different electrodes

---

Fused Sulphate lead  
iron & Carbon electrodes

40 deg deflection on Tang  
gal. high resist Coil &  
20 Siemens units resist  
outside -

deflection  
over

May 30 1942 TAC

def to right

fused phosphate soda fuses  
easily - 9mm + Carb electrodes  
40 deg on gal - <sup>just</sup> works well  
140 ohm relay -

addition Caustic Soda  
makes no difference in  
deflection - addition  
peroxide manganese solidifies  
it + goes to zero, bad  
mixture, Manganese Conducts  
easily - over

May 30 1882 928

Sulphate lead chloride  
 Soda, Iron + Carb with  
 Sul Lead alone upon  
 high temperature. (fearful)  
 gives 40 deg. addition  
 Caustic K gives 40  
 def contrary direction  
 def to right  
 508

May 30 1882 Sat

Nitrate Soda, <sup>Caustic Soda</sup> Fe + C Electrode  
 35 deg deflection to right. dark work  
 WU relay - hard to  
 melt. couldn't melt  
 without Caustic.  
 but suppose if got temp  
 high enough I'd do it.  
 Experiment not satisfactory  
 Nit Soda appra gave off  
 something that burns

May 30 1982 T &amp; E

Just tried ~~to~~ made some  
leafy lead by pouring molten  
lead from height into water  
the lead to be used  
with or without lead  
plates in storage battery

=

Course Potash Bicarbonate  
Palash Constant Current  
to left - Current to  
left was - during of  
Carbonic acid. I think  
40 deg deflection constant  
if maintained hot,

May 30 1882

27

Stern by dropping the  
 lead 36 feet got it more  
 porous -- made a plate  
 afloat for storage bat  
 which was disturbed just  
 as it got mushy --  
 making a sheet lead  
 which just a cooling  
 is pot full holes dip of  
 brush to increase  
 contact.

May 31<sup>st</sup> 1882

Sulphate Potash, good  
 with 20 alum  
 goes 60 to right - requires  
 400 Sulfuric Units to  
 reduce  $\pm$  to 20 deg.  
 deflection = Fat. Carbon  
 strongly caustic if iron  
 is corroded, requires  
 high heat to react,  
 Martin finds iron is  
 attacked - but temperature  
 solution so high may be  
 atmospheric oxidation  
 on bath iron? - Relay  
 works well, with caustic Na  
 50 deg only, requires 200 alum reduction to

May 31, 1882

20 showing lessening Res -  
 addition little sulphur 5.4  
 to right 500 ohms added  
 reds ~~was to~~ left to 20  
 on strap 1 deg showing  
 high res. works relay  
 pretty strong

500 ohms 14 on fun Coil  
 14 on strap



May 31 1882

Bichromate Potern: couldn't  
 melt. 1.5 Ohm & Cent Electrovis)  
 would not work. 1/40 Ohm.  
 W N Relay got a deflection  
 to the right, of 42 deg on  
 fine coil with 500:8 Units  
 Tried slowly 2 deg;  
 deflection showing very high  
 resistance. Afterwards added  
 some caustic soda, then  
 it would not work either  
 Relay nor give any deflec-  
 tion. It seemed to destroy it  
 entirely.

May 31 1882

Chromate Lead. requires high heat to fuse it. Would not work relay. 12 deg left, 500 ohms, Only 2. deg. in strap with no res, hits the iron strongly, Afterwards added some phosphate of Potassium fused again to a liquid this only gave a deflection of 24 deg. on fine coil with no res in. On strap it only gave 2 degs in both cases deflection to the left

Am

May 31 1882.

Cr. Sulphate Sodium

fused, at pretty high heat,  
This worked relay very well,  
and on Galv. with 500 ohms<sup>res</sup>  
it gave a deflection to the  
right of 34 deg., and on the  
strap it only gave 14 deg  
with no resistance showing  
it to be of pretty high res.

Noticed that it eat the  
iron quite strongly.

May 31 1882

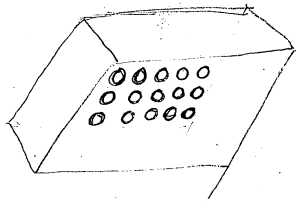
Epsom Salts, <sup>this</sup> decomposed  
at a high heat to a white  
powder, tried it ~~on the relay~~  
on the relay and Galv but  
could get nothing, I then  
added some Caustic Soda  
then fused it to a liquid.

This at first on Galv  
fine coil, gave a def. to  
right of 4 deg, then it  
went to left 3 1/2 deg. and  
on. Sharp it gave 4 deg. def.  
to left, Neither Electrode was  
attracted

May 3, 1882

Sul acid pure & Bi Chrom  
 pot 40 deg left too slow  
 20 deg in strap no res, Int  
 work in lay - requires fearful  
 heat to fuse it =

---



June 1st 1882

Terracyanide. Pot. fuses easily, would not work relay. On gal. fine coil with 500 ohms, gave a def. of 4 deg. to right with no res gave a deflection of 50 deg to right.

Then added some Caustic Soda, but did not help at any, then added some Phosphate Sodium with no better results. Neither Electrode was attacked.

June 1<sup>st</sup> 1882

## Acetate Lead.

Takes fearful heat to  
fuse it tries it on relay  
& Gal. and it was M.G.

I then added some.  
Caustic Soda this made  
somewhat better, it would  
not work relay on Gal. with  
5<sup>th</sup> ohms gave a deflection of  
18 deg. to left with no res.  
Deflection of 6.6 deg. on  
the strap. no res. gave a  
def. of 18 deg. and not attack  
circuit Elect

June 1st 1882

B. Carbonate Pot. Reagents

High temp. to fuse

Would not work relay  
on fine coal of Gal. white  
300 ohms res. nothing but as

I decreased res. it gradually  
up to the left and when all  
the res. was out it gave a  
def. of 3.6 deg. On the strap  
nothing, showing high res.  
Carbon Elect. was eaten away some

Afterwards added some lime  
this gave me a def. to right with  
300 ohms. 4 deg.



June 1st 1882

Sulphate Lime fused quite easily but soon evolved leaving a white powder. Probably oxide of lime, tried it on Delany and it worked it very well. On Gal. with 500 ohms gave a def. 38 deg to right

I then added some Phosphoric Ammonia. With 300 ohms in. got a def. of 38 deg. I then cut out res and got a def. of 68 deg to right

---

J. S.

1 SE = 9,9536 Ohm  
 50 48.6/8.0  
 48.

June 1st 1892

Chloride Ammonia,

NH<sub>4</sub> decomposed by  
 heating, to a powder  
 I then added some  
 phosphate Sodium, and  
 fused it to a liquid. This  
 worked bang up. Got a good  
 current on delay and on gal,  
 fine soil 50 ohms res. 38 deg  
 with no res. 60 deg. def to  
 right, both Electrodes was  
 attacked, ~~but~~ the carbon  
 being pretty badly eaten,

June 12 1882

Yellow Prussia Pot

Easily fused. Would  
not work Relay, but  
in Gal. fine coil 50 ohms

Res. def. 8 deg with no

Res. 54 deg. to right

and on cooling off it  
went to left and gave a  
def. with no Res. 38 deg  
with Res. 2 deg. Elect.  
not attracted.Added Bisulphite to do  
but it made no difference  
also added Lime with  
the same results.

June 1st 1882 55

Took some common  
linseed oil and a trust that  
brought it up to a red heat  
I could not get anything  
from it. I then added  
some Caustic Soda, and  
heated it up again, stirring  
it well. Then I got a def.  
on Gal. fine coll. with no  
Res. to def. and with 50  
grms. Res. got a def. of 10  
def. to left. but it would  
not work M. K. L. any

over

June 7<sup>th</sup> 1882

Scrap Zinc very easily  
fused this was N.Y.

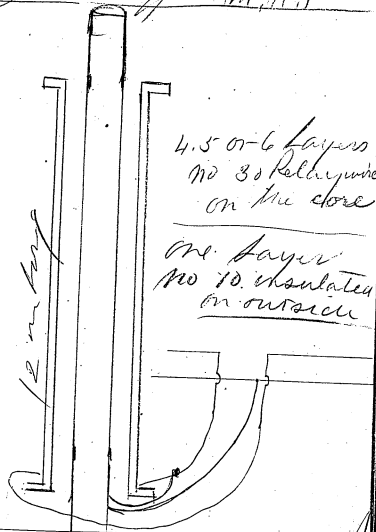
Also tried scrap lead with  
same results added some  
Phosphate Sodium but did  
not make it any better  
did not get any current  
from either one

June 30, 1882

June 2. 1882  
Common table salt

~~Jan 1882~~  
~~Jan 1882~~  
~~Jan 1882~~

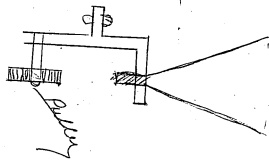
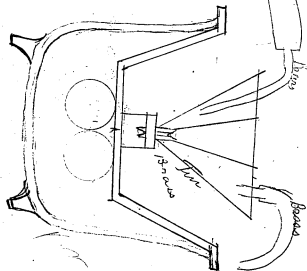
Jan 1882



4.5 or 6 layers  
 no 30 Relay wire  
 on the core

one layer  
 no 10 insulated  
 on outside

June 26 1882  
M, Ch, F

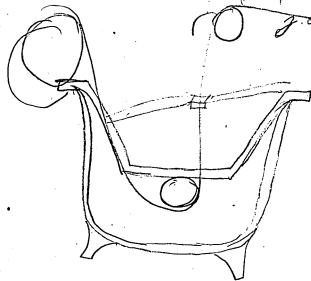




June 28 1892 65

M.H.F.

70 J.S.O.



Sept 30<sup>th</sup> 1882 67

Experiments tried for  
building up ends of  
fibres.

Dilled small pieces of  
cast ~~flint~~ and coconut  
shell. Also split some of  
them two thirds down with  
a saw then put the bamboo  
fibres in with sugar-coal  
tar and Japan then carbon  
ized them. But in every  
instance I found the ~~the~~  
substance used contracted  
twice that of fibre leaving  
the high points in contact  
only

~~Sept 3~~

Oct 2. 1842

Wound some of blanks O.N.T.  
 No. 1.10 Spool Cotton on the  
 ends of fibres then boiled  
 Sugar and carbonized.

This came out in a  
 spongy mass

Also drilled and split  
 bast fibres and fastened with  
 resin and carbonized

In carbonizing bast  
 fibre wrapped leaving  
 poor contact

Oct 2. 1882

also took a small  
Strip of parchment paper  
covered with Japan and  
wound around the ends  
and carbonized.

This carbonized in scales  
leaving fibre loose

also made filings of  
Bamboo, White Holly  
Box Wood, etc. then  
saturated with coal tar  
then pressed in a mould

This carbonized like a  
honey comb, but carbonized  
closer to fibre

Sept 2 1872

also drilled pieces of  
graphite and put fibers  
in with eod. Ton and  
carbonized

Due to the difference  
of contraction ~~between the~~  
~~the fibers~~ the fibers  
come out loose

Oct 8 1900  
M. A. Fisher

# Bamboo Ends

Long one put on with Coal Tar

Next " " " " Japan  
" " " " " Pitch  
" " " " " Boried Sugar  
" " " " " Plumbago & Tar

Long one Pitch & Linseed  
" " Coal Tar  
" " Japan

Two long unglazed fibres  
One short fibre put on pitch & boried  
sugar  
Two short fibres put on with pitch



New York Dec 2, <sup>77</sup>82  
M. M. Force

Secondary battery exper

Took some oxide of lead  
(small amount) and mixed  
it with a minimum amount  
of diacetin made a cylinder  
of it then put it in a tube  
and passed gas through the  
tube and kept heating the tube  
with a bunsen burner until  
it was reduced to metallic or  
finely divided lead

Works OK

George Gibbs.  
Thos P. Cowart

J. F. Ott

New York <sup>Jan 5<sup>th</sup></sup> Dec 4 1879  
 Mr. M. Force

Made some more of the same mixture and put a lead wire through the center to make connection to. But this did not work so well as the lead wire running through the center melted or seemed to wear away.

Mr. Edison suggests that the cylinders be made hollow and pour the lead in after the cylinders have been reduced.

H. Edison

J. F. H.



New York Dec. 4<sup>th</sup> 1882<sup>81</sup>  
 W. H. Jones

Insulating commutator brushes  
 by plastic Paris.

Made two brushes of copper  
 wire fifty wires in each brush  
 and insulated them with plastic  
 Paris.

July 21 1884 JAE

Used strong sulphuric acid  
 Carbonate glass - then  
 acid. Also some iron  
 also chlorine and bromine  
 K also used also  
 potash and some phosphorus  
 also chlorine pot,

Very good same about as  
 but acid is being  
 phosphoric acid got to be.

July 21 1884 JAE

Used strong sulphuric acid  
 and also chlorine and bromine  
 heating there is strong explosive  
 bubbles continue to arise  
 only 7 deg, then 10 deg -  
 11 deg then 12 deg -

July 21 1884 JAE

Working very strong S<sub>2</sub>O<sub>8</sub><sup>2-</sup>  
 and also with pot, & acid, cold  
 in deflection just as in boiling  
 in deflection just as in boiling  
 colored red, boiling green  
 15 @ 100 only 10 with 7  
 then in acid is with 1/2 fa  
 as black or manganese -

July 21 1984  
MNF

Done of Oxidation Experiment with  
Carbon - Plant & Strong Sulphur  
heated air passed through -  
to supply oxygen to Carbon  
works fairly

---

Sulphur - Flow Sulphur  
Carbon & plant not good

---

July 22 1884



T & E  
carbon 14 H.F.  
plant

Lad Chamber  
containing samples  
from hydrogen

heat

Not strong only 3 legs with  
no gas, shows its not the  
gas from the Peroxide but actual  
Contact,

To George S. Johnson  
 1000  
 1000

Thompson  
 1000  
 1000

Thompson

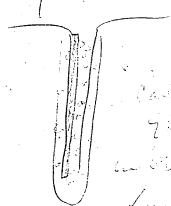
Wanda

Wanda

Wanda

Terrafina

July 22 1884



Carbon  
 Sulphur  
 in solution with  
 Lamp for ox. res  
 & Sul acid

Splendid gives 10 deg  
 through 37 ohms res

We put porous partition  
 powdered Carbon in contact  
 in Carbon & Peroxine on plat  
 ok But porous partition cons.  
 res

34

37

July 23, 1884 -

102. now try pyroxylin  
Carbon monoxide instead  
instead of pyroxylin, not much def -

---

Sulph Perox Barium  
Carbon monoxide  
gives good deflection but  
unstable all or comes off  
we now try peroxide lead

July 23-

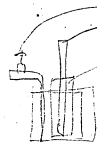
passing air thru water could it



Zinc

Sulphuric acid  
and the water in Black ox  
solution

Sulphuric

filled with Peroxide of  
Barium

July 23 1884

bladed Carbon with pencil. 117

put it with fresh Carbon.

Shiny Seal - 10 deg

Calc. - 10 deg

Therm. - 10 deg

10 deg this day

4 deg in air - 10 deg in water

2 deg in air - 10 deg in water

1 deg in air - 10 deg in water

0 deg in air - 10 deg in water

-1 deg in air - 10 deg in water

-2 deg in air - 10 deg in water

-3 deg in air - 10 deg in water

-4 deg in air - 10 deg in water

-5 deg in air - 10 deg in water

-6 deg in air - 10 deg in water

-7 deg in air - 10 deg in water

-8 deg in air - 10 deg in water

-9 deg in air - 10 deg in water



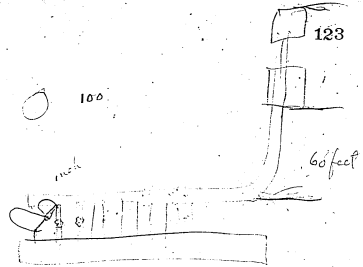
July 20 1889

Req Carbon and but with  
 miscellaneous apparatus  
 with Carty's Bulletin &  
 peroxide lead carbon  
 Electrode zinc + chi  
 ammeter 100 ohm  
 10 ohm on strap.  $\frac{1}{2}$   
 with Resistor  $11\frac{1}{2}$  —  
 12 10 ohm — 1220 12 ohm

July 23 1884 -

Blackoxman Corn purchased  
with powdered Coke. Zinc &  
Carbon Sulphate 504 -

11  $\frac{1}{2}$  12 25 pm - pulping  
gas to 7  $\frac{1}{2}$  at 12 27 stops  
at 7  $\frac{1}{2}$  12 30



15 pipe inch dia.  
 $\frac{1}{2}$   
 16. 50. 100.  
 50. 150.  
 $30 \frac{1}{2}$   
 60.

3000

85

Jersey City

Electric repairing 150. mo

Eng &amp; furnace 1 man 75

9 line men @ trimmer,

6 mos team 100 lamps 50c per night  
 Cleared 2200. ~~some~~ don't cover  
 dipen.

Dexter house 24. 1/2  
 plant cost 3000, land  
 1500.00 too much 135-

Lamps - Everything. Most  
 glass pattern in 200.  
 plant, Balls of Reading

July 28 1884 TAE

127

Direct production of from Carbon &  $\text{H}_2\text{SO}_4$ .  
 10s sealed Sul Acid, in glass tube  
 with leading in platinum wires  
 one pale platinum other Waller  
 Carbon, put lumps black oxide  
 Manganese crude with 10g  
 Ohms in ct gal went to 8 @ 9  
 9 only after while when tube  
 exploded violently - it went  
 quickly to 8. There was too  
 much water in acid - going use  
 strongest acid then try =

Tried phosphoric anhydride +  
 peroxide manganese, gal  
 went to 3 without revolution  
 Cell cracked its very syrupy  
 must try in concrete as glass  
 melts over

July 28 1884 TAE

It acts on peroxymang to form a  
Violet colored Substance,

We now try caustic soda +  
also caustic pot ash from  
sticks -

note = with Sul acid I think the  
action is either 1 of 2 ways:  
Sul acid Decomp to  $\text{SO}_2 + \text{O}$   
 $\text{O}$  Combines with Carbon to  $\text{CO}$ .  
 $\text{SO}_2$  reduces  $\text{O}$  from per oxide to  
form  $\text{SO}_3$  - or water of Sulc  
decomp +  $\text{O}$  Combines with  
Carbon to  $\text{CO}$  +  $\text{H}$  reduces  $\text{O}$   
of peroxide Mang to form  $\text{H}_2\text{O}$ .

July 28 1887 TAE

Caustic Soda & peroxide  
 Mang Crude - cracks glass  
 when put in large lumps -  
 we now powder & put in -  
 it goes up to 12 with lat's  
 peroxide, but with 7  
 shows only 5. longer heating  
 make it go down nearly to  
 Zero with no Res, there is  
 evidently great deal oxy  
 given off - from per oxide Mang.

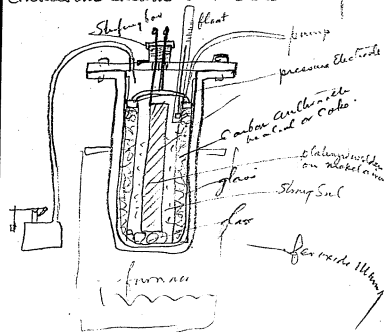
July 28. 1884 -

We now try some Nordhausen  
 fuming Sulphuric acid with peroxide  
 Mang Crude with plat + Carbon  
 Electrodes heated to boiling in  
 test tube cell. This acid is as good  
 as 3 square Miles of Hell.  
 Martin got burnt on the face;  
 no better than Corned. 27 @ 50 shun  
 10 dig -



July 25 1884 TAE

Boiler large Scale for direct  
Conversion of Carbon into Electricity



July 28 1884

Things to try in direct  
conversion Carbon into E.

Peroxide Palao-seum fuses higher point  
than Cautic K. at white heat decamp  
into K monoxide & O, use this,

Also Sodium Dioxide  
" Calcium Dioxide  
" Strontium "

for withstanding of Hot Deal a.

Chromoso-Chromic oxide formed by  
Electrolysis Salalium Chromous  
Carbamide, Chromic Chloride  
by current low intensity  
black powder insoluble in any  
acid Cr 4 O 3 -

July 29. 1884. Continued 141

Chromic Dioxide soluble only  
in Concentrated Sulphuric acid  
not in acid with 16 @ 17 pct Water.

Lead Chromate in  $SO_4$

Molybdenum trioxide fuses red heat

Tungsten trioxide

Antimony trioxide + pentoxide

Bismuth trioxide fuses red heat

Sulphur when heated decamp  
to  $SO_2$  + O this takes place  
same temperature as heating  
per or manganese.

July 29 1884 Continued

for withstanding Sul acid heat

"On heating to red heat only the neutral Sulphates of the alkalis of the alkali earths & lead remain unchanged

At the temp of melting iron the two latter classes are decomposed but alkali

Sulphate Valerianate decompose

Zinc & manganous Sulphate are so difficult to decompose that in practical work considered fusing

Phos anhydrous boric oxide above red heat

July 29 1854

10% new try dilute Sul acid  
about 30 @ n-pot water -  
it works OK - not any much  
dif from Case

We try in crucible in forge  
Sul acid & Blk ox, ok but  
fumes so bad of  $SO_3$  that  
Martin spit blood & I was  
nearly overcome; Borax acid  
& Blk Ox mung not good  
NaO & Sesqu Fe ng current  
from plat same with  $MnO_3$   
~~we~~ tried sal zinc &  $MnO_3$   
ng - used lat clings ng

13 8  
1 lb 33000 for 1 hour

5000.  
30000  
2/270  
135  
90000  
2700000  
135  
675  
2505  
550  
250  
1085

Jewelry Mac Gooling July 28 1884  
Zinc Carbon - porous Cup - 147228  
M, 4, 2

No 1

Water with Sul acid. - zinc in  
porous cell. Black oxide Mang  
+ powdered coke, -  $\frac{1}{2}$  +  $\frac{1}{2}$  -  
20 cc Sulphuric acid in water  
pour some water with Sul strong in it in  
porous put let me judge of quantities;

2nd

Water with Chloride Ammonium  
porous cell carbon powdered +  
black oxide Manganese,  $\frac{1}{2}$  +  
 $\frac{1}{2}$  use Coke -

3rd Water with Chloride Ammonium  
in porous cell use - powdered Coke  
 $\frac{1}{2}$  + other half of ~~normal~~  
~~quantity~~ of Chlorate Potash

July 29. 1884 <sup>MMT</sup> 149

4 - Chloride Ammonia in water  
 Porous cell mixture Coke,  $\frac{1}{2}$   
 other half made of equal  
 quantities of Chlorate Potash  
 & Black oxide manganese.

NO 1. The stuff in porous cell being  
 mushy molasses like -  
 on strap ~~22~~ 23 gives 10  
 deg 90 ohms thro 190  $4\frac{1}{2}$   
 $2\frac{1}{2}$  through 390 - Very powerful  
 on 3 ohm Souder shorted  
 10 o'clock night 29<sup>th</sup> -

July 29, 1884  
 No 5 Sul acid water. 151

mixture Chlorate Potash  
 + Coke =

No 5- 8 on strap 90 ohms

10 deg - 190 ohms

$2\frac{1}{2}$  390 ohms

after 10 minutes 15 on strap  
 Shortcited at 1015 pm 29th

No 46 battery 90 ohms 10 after

5 on 190 ohms  $2\frac{1}{2}$  on 390 ohms

10 on strap - shortcited  
 at 1030 night 29th



No 2

July 29 1884

M. M. A.

153

10 deg on 30 ohms 4 deg  
on 90 ohms  $2\frac{1}{2}$  on 190 ohms  
 $2\frac{1}{2}$  deg on strap, very  
poor on Sounder, short cked  
at 1050 night 28

No 6 - Coke + Glacial ox  
+ dichloric acid weak  
strap 14 90 ohms 10  
190 ohms 5 390 ohms  
 $2\frac{1}{2}$  Very strong on  
Sounder, short cked at  
11 pm 28<sup>th</sup> -

at 11 10 pm Reading of <sup>155</sup>

No 1-

July 29

strāp 10 50 ohms 10

90 ohms 6. 190 3°

290 1½°

11 12 pm 28.

No 5- 90 ohms 9° 190-4

390-2 strāp 17

No 4 strāp 5 11 15 pm 28

10° on 60. 8 on 90 ohms

4 on 190- 2 on 390

NO 2 - 1117 pm <sup>July 7 884</sup>  
 29 <sup>157</sup>  
 strap  $1\frac{1}{2}$  10° on 10 ohm  
 palaygo shaking Carbon  
 makes it go up

NO 6 - 1118 pm 28

strap 12 10° on 70.  
 8 on 90 4 on 190 ohm  
 2½ on 390 -

old Cell that was shorted  
 2 nights & now been  
 1 hour shorted  
 24 ohm 10 degs -  $2\frac{1}{2}$   
 strap 5-6 Shaking Carbon  
 (10) loosening it & pulling it out  
 30 ohm 10 deg

No 2 July 30 - 1884 159  
 10 left thru 12 ohms 9.00.5<sup>11</sup>

---

No 5-

50 ohms 10° 90 ohms 5  $\frac{1}{2}$   
 190 3° strap 10.

---

No 1 strap 4

30 ohms 10 deg 70-5°  
 170 3°

---

No 4

13 ohms 10 deg 53 ohms 3

---

old cell in night

13. ohms 10 deg

30th July 7.40 pm —

105 — 4 on strap

30 ohms 10° — 5° on 70

2 on 170 —

104 — 7.43 pm —

Strap 1/2 — 10° on 4 ohms

102 — 7.45 pm —

1/2 on strap 10° on 3 ohms

106 — 7.47 pm

Strap no deflection 7° no Res

30 July -

748 pm -

163

No 1. Strap.  $2\frac{1}{2}^{\circ}$  10 on 13 ohms

Reg Carbon Cell short ckt'd

9.30. July 30th

~~ch~~ ~~p. 16.~~ strap  $9^{\circ}$ ~~40~~  $10^{\circ}$  37 ohms. 77 ohms  $4\frac{1}{2}^{\circ}$

| No 1 | Time        | Stop  | 10 through | Time              | Stop | 10 through | 165 |
|------|-------------|-------|------------|-------------------|------|------------|-----|
| No 1 | 10 pm 28    | 23    | 90         |                   |      |            |     |
| No 5 | 10 15 " 28  | 8     | 90         |                   |      |            |     |
| 4    | 10 30 " 28  | 10    | 90         | No 1 + 4          |      |            |     |
| 2    | 10 50 " 28  | 2.5   | 30         |                   |      |            |     |
| 6    | 11 pm 28    | 14    | 90         |                   |      |            |     |
| No 1 | 11 10 pm 28 | 10    | 90         |                   |      |            |     |
| " 5  | 11 12 " 28  | 17    | 97         | 5 + 6             |      |            |     |
| 4    | 11 15 " 28  | 5     | 60         |                   |      |            |     |
| 2    | 11 17 " 28  | 1.5   | 10         |                   |      |            |     |
| 6    | 11 18 " 28  | 12    | 70         |                   |      |            |     |
| 9 am |             | 38    | 113        |                   |      |            |     |
| No 1 | 9 30 am 29  | 4     | 33         | 5 11              |      |            |     |
| " 5  | " "         | 10    | 50         |                   |      |            |     |
| 4    | " "         | —     | 13         |                   |      |            |     |
| 2    | " "         | —     | 12         |                   |      |            |     |
| No 1 | 7 40 pm 29  | 2 1/2 | 130        |                   |      |            |     |
| 5    | 7 42 " "    | 4     | 30         |                   |      |            |     |
| 4    | 7 42 " "    | 1 1/2 | 4          |                   |      |            |     |
| 2    | 7 44 " "    | 1/2   | 3          |                   |      |            |     |
| 6    | —           | 55    | 00 300 50  |                   |      |            |     |
| No 1 | 12 noon 30  | 3.5   | 20.        |                   |      |            |     |
| " 5  | " "         | 1     | 13         |                   |      |            |     |
| 4    | " "         | 0     | 00 10      | cleaned it out    |      |            |     |
| 2    | " "         | 0     | 2          | cleaned it out    |      |            |     |
| 6    | —           | —     | —          | gave up — cleaned |      |            |     |

No 5 twisted Carbon 167  
 around, 8<sup>30</sup> pm - 29<sup>th</sup> = 4 mi strap  
 10° ~~30°~~ - 40° added  
 little water =

July 29 9 pm -

New Cell, NO 7 -

Chloride ammon in outer cell.

(Carbon) packed with crystals

Chlorate K + water with little

water - Chlorate K being

soluble in ammon chloride -

10 dm 30 mm - 50°

12 collected at 9 pm

30,



July 30. 9 am

No 8 = 10 a 1000 <sup>5.4</sup> ~~to~~ <sup>to</sup> grow

cell filled with liquid

cell filled with liquid

 $\frac{1}{2} H_2O + \frac{1}{2} O_2$  - power109 ohms  $10^\circ$  deg 207,  $5^\circ$ 507  $3^\circ$  —  $34^\circ$  on strap

9:15 pm 30th shock (carbon none)

101. given  $10^\circ$  then 30 ohms $3\frac{1}{2}$  on strap out fresh

bring 500 in cell

strap 7 deg - 30  $10^\circ$  —

shaking &amp; adding water

54 oh  $10^\circ$  8 on strap

9:30 - 5 on strap - good

50.

10.

1 600  
 2 300  
 4 150  
 8 75  
 16 37  
 32 18.75  
 64 9.375  
 128 4.6875  
 256 2.34375  
 512 1.171875

July 30 1881 9.50 p.m. - 171

No 9 - Carbonised packed.

like size pie, then crystals  
 ammonium sulphate put in  
 & 8.5 g added  $\frac{1}{2}$  to bulk  
 into 100 cc. 0.5M HCl  
 acid outside 30 in strip -

130. above 10 deg.  $\frac{1}{2}$  in  
 |||

Short ckt at 10 o'clock p.m.  
 30th =

Nitric acid + packed perox. neg. + 173  
Carbon - Nitric acid in water cell -

cells above with substitution per  
Lead -

Try Chlorate K in previous use  
potash, sol -

Phosphate Soda - also Sulphate Ammonia

Try test tubes of fused borax.  
plat + Carbon -

Storage battery with fused

Borate Lead - various electrodes

12.

4.

35  
 12  
 240  
 240  
 1840

24  
 36  
 4

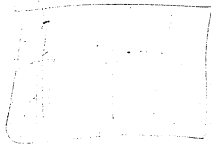
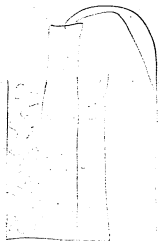
24  
 4

| No | Time & Date  | Shopside | 10' through<br>— shed | Remarks      |
|----|--------------|----------|-----------------------|--------------|
| 7  | 12 noon 30th | 1        | 8-                    | cleaned ribs |
| 8  | " "          | 10       | 37                    |              |
| 9  | " "          | 10       | 24                    |              |
| 10 | " "          | 7        | 20                    |              |
| 11 | 9:29 9th     | 12       | 30                    |              |
| 8  | " "          | 34       | 109                   |              |
| 9  | " "          | 30       | 130                   |              |
| 8  | 3:30 pm 30th | 7        | 17                    |              |
| 9  | " "          | 8        | 26                    |              |
| 1  | " "          | 4        | 20                    |              |
| 5  | " "          | 2 1/2    | 15-                   |              |
| 6  | " "          | 6.       | 22                    |              |
| 1  | 12 noon 31   | 1 1/2    | 7                     | cleaned ribs |
| 5  | " "          | 2        | 17                    |              |
| 8  | " "          | 2        | 12                    |              |
| 9  | " "          | 8        | 30                    |              |
| 10 | " "          | 5        | 20                    |              |

176

00

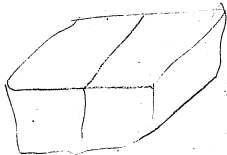
177



~~4 1/2 lbs~~

1 lb per horse power.  
~~12~~ lbs Chlorate.

~~4 1/2~~  
 4 lbs -



$$\begin{array}{r} 4 \frac{1}{2} \\ 16.0 = \\ \hline 20. \end{array}$$

12°

Bergmans Battery

Amal Zinc SO<sub>4</sub> + H<sub>2</sub>O -

porous cell 5 oz chlorate.

Put + Sulphur -

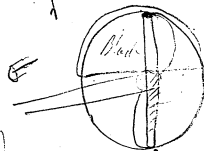
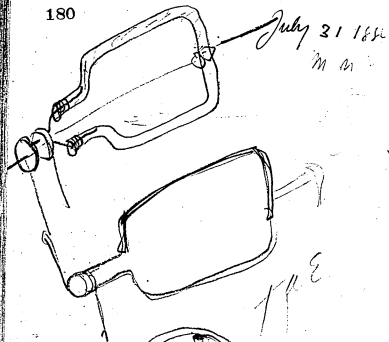
18 on straps new porous

cell - 90 shms 10 deg  
 defln -

Ditto with Coke + Chl pot  
 + strong Sal de

• 110 on strap tremulous.

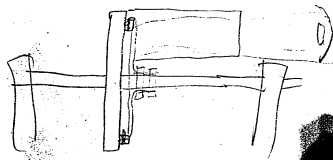
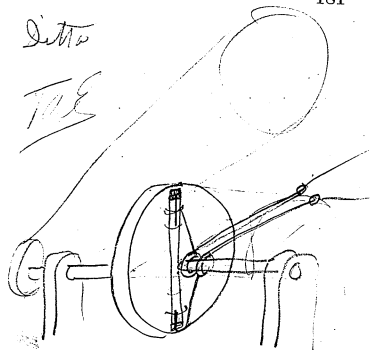
130 shms 10 deg -

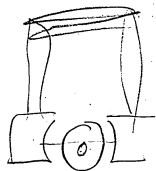


For turning light into  
electricity

Set to

TAE

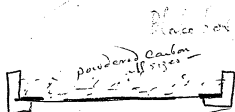






Oct 8 1884  
 Telephone Experiments. TAE 187  
 C. F. Fitts

Telephone.



Plate

Oct 8 1884-

Telephone Experiments

25th

We now try with trans on 187.  
 with 2 BT Cos Cells a regular  
 Edison coil, hand phone, then we  
 change by switch over to a reg  
 Edison secondary but have 10 diff  
 primary that we can slip in  
 running from No 16 17 18 20 21  
 22 24 26 28 30 wire, to obtain  
 best resistance for this trans &  
 battery -

Edison Reg load -

64 ohm coil 5 times weaker

34 ohm " " "

24 " 3 " "

12 " 2 " "

Oct 8 1884 Tel 191

Telephane Expts.

7 alms. ~~1~~  $\frac{1}{2}$  loudness as reg3.25 "  $\frac{3}{4}$  "1.28 "  $\frac{4}{5}$  "

.44 nearly same "

.53  $\frac{5}{6}$  "

Lower coils not so loud  
 We are now winding lower res coils.

The Coil twice as long is about same  
 as regular perhaps not quite so  
 loud

We try Experiment of adding  
 battery to each coil of diff  
 res until its same loudness  
 as regular Edison

1st 2 along BT Co Cells

1.28 primary coil. with 2 BT Co  
 & 1 Carbon as loud as regular  
 with 2 BT Co & 3 Carbon Hunt  
 Ear but only the jangle - it  
 very loud -

3.25 alms. with 4 cells ~~not~~  
 2 of BT Co 2 Carbon loud as  
 regular with 6 louder release  
 with 8. no louder.

7 alms. 5 cells louder  
 regular.

Oct 8 1884 <sup>1885</sup>

12 ohms & cells  $1\frac{1}{2}$  as loud  
as regular

---

24 ohms poor with 8 cells.

---

12 ohms & cells  $1\frac{1}{2}$  as loud  
as regular

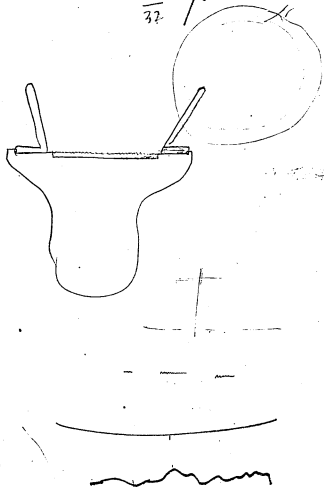
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34 ohms poor with 8 cells

---

Oct 8 1884 Marion

Used rubber ring with  
 & two paper diaphragms  
 $1\frac{1}{2}$  inch apart filled  
 with fine coal carbon  
 the articulation was  
 good but not loud  
 except in one position  
 This was lost after  
 talking a little while  
 John Ott is now  
 putting some lamp  
 back between them

 $\frac{1}{32}$   $\frac{1}{32}$ 


Oct 9 1884

TAE

I think I have clearly in my mind the proper theory of constructing a loud telephone & the most powerful utilization of the exhaled voice to produce the maximum change of resistance. Thus this use a hard button of Carbon crosshatched to give innumerable points have this button 2 to 4 inches in diameter resting on a hard flat metallic surface connecting with one pole - over the button have a soft yielding sheet such as chamois oiled Cotton etc faced with platinum foil or Carbon paper foil - secure the edges only to prevent moving but do not stretch in the least let it lay dead on the button now have a very low resistance primary & talk direct to the soft sheet, the strength of the sound waves is the same in every part of the soft armature hence unlike a diaphragm equal pressure will be placed in every part of the Carbon & the exhaled power of the voice used to make the initial contact, while with heavy foil or diaphragm the pressure is great at one spot but one does not get the full benefit of all the pressure as the Carbon makes its greatest.

Oct 9 1884 201

TAL

Change in the first part of the wave  
doubling the pressure scarcely makes  $\frac{1}{2}$   
change further & so on while with  
my arrangement the  $\frac{1}{2}$  initial sensation  
of the Carbon is only used.

Didn't turn out so  
well as expected Oct 11 1884

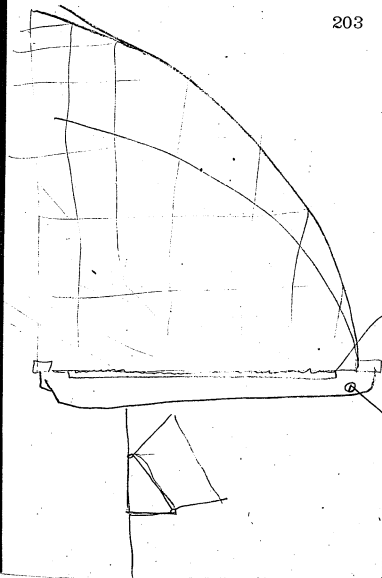
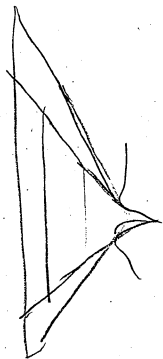


very thin Carbon -



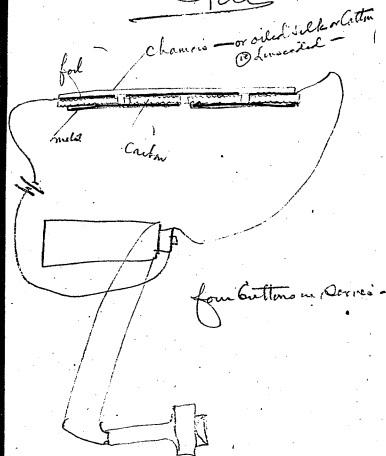
much finer  
than this  
80 @ 100 to  
inch.

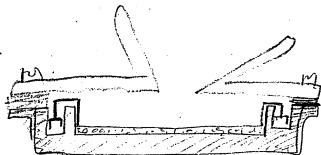
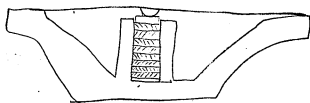
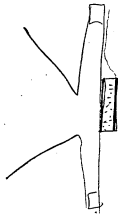




Oct 9 1887

J. S. V. 1887



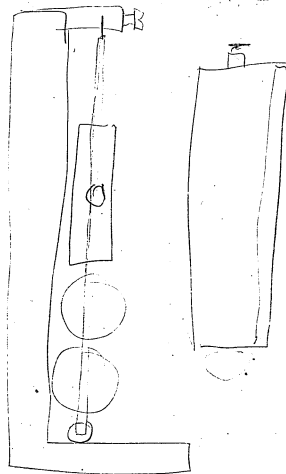
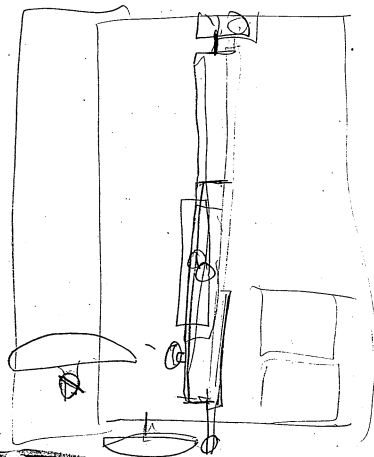


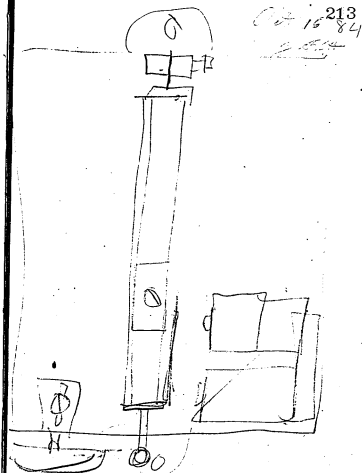
J. F. C. H.



*Drawn out -*







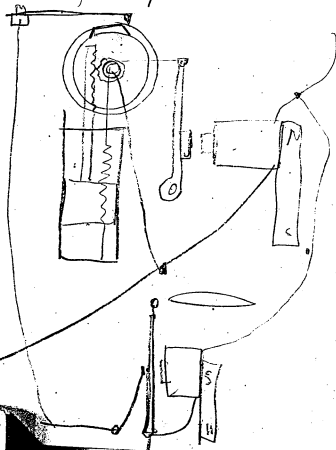
Oct 12 1884

Schedner's machine

Tae

Telephone

J. O. H.



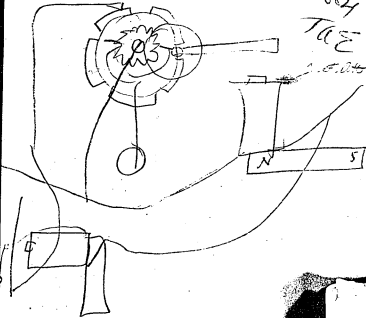
Schedner's machine

Telephone

Oct 12 1884

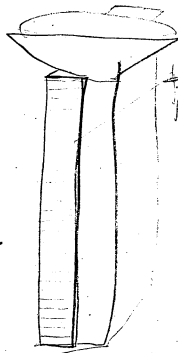
Tae

J. O. H.



The  
 Washington  
 Natchez  
 Wa  
 Harrington  
 Harrington  
 Washburn  
 York  
 York

Square Plate Telephone



Schroder

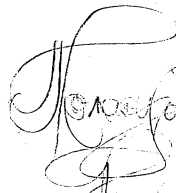
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2.5.00

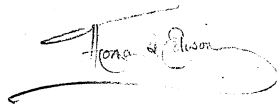
to present

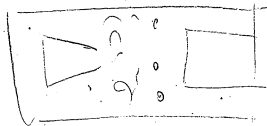
plg—



  
 George Chapman  
 London

  
 John Chapman

  
 John Chapman



Martin

Try the following only  
 bringing them to a point  
 at first & if they don't  
 work increase the heat  
 so that the Carbon rod  
 will get a little red  
 a short distance from  
 the surface of the  
 liquid.

first try with the  
 sounder afterwards  
 with the galvanometer  
 using the two binding

②  
 Paste that has the paper  
 in the galvanometer  
 should stand at zero  
 when no current passes  
 note the deflection  
 on the galvanometer  
~~when~~ and the kind  
 of salt there is used  
 Use the clay exactly  
 as that used.

Common phosphate Soda  $\frac{9}{44}$  X

+ Sulphate Potash if not put in  
some sact potash -

X Sact potash or Nitrate Potash  
or Nitrate Soda, if not  
add Red lead -

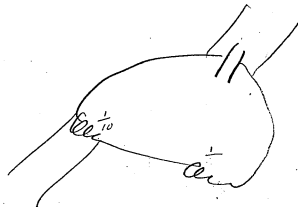
X Caustic Soda  $\frac{3}{4}$  - Bichromate  
Potash  $\frac{1}{4}$  =

Sulphate lead X  
afterwards put in pieces 40  
of Caustic potash

~~Sulphate lead & Caustic~~  
~~potash~~

Caustic Soda  $\frac{1}{2}$  - Black ox  
Manganese  $\frac{1}{2}$  -  
Stir well -

Chloride lead -  
afterwards put in  $\frac{1}{5}$   
Caustic Soda.



Menlo Park Notebook #204 [N-82-05-26]

This notebook covers the periods May-July 1882, March 1883, and April 1885. The entries are by Edison and John Ott. Some of the entries were witnessed by Charles T. Hughes. Most of the material relates to electric lighting. Included are drawings of armatures and notes and drawings of automatic voltage regulators, lamps, and meters. Included also are notes and drawings of the sextuplex telegraph and notes relating to a process for compressing bran. A few pages appear to have been used by a child for drawing, writing, and math exercises. The book contains 278 numbered pages.

Blank pages not filmed: 8-9, 80-89, 112-119, 126-137, 144-147, 150-151, 154-161, 170-203, 208-237, 256-261, 266-271.

Missing page numbers: 97-98, 109-110, 273-274.

LIBRARY OF THE  
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

From Library

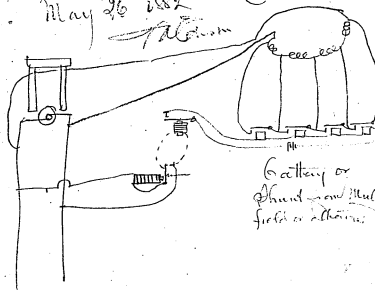
HH Printed 50 7/8.

May 1, 1896

Automatic Regulation <sup>1</sup>

May 26 1882

Johnson

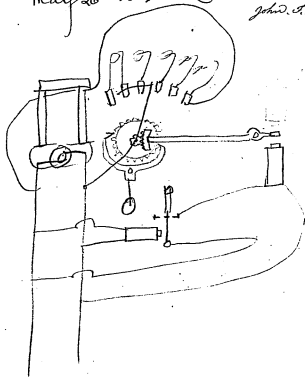


Works hang up

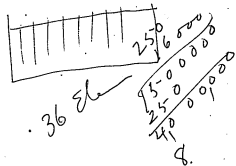
Johnson

John F. Ditt

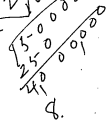
Automatic Regulation  
May 26 1882 T. Edison  
John W. F. 1882







36 sh



1003

3.

32.

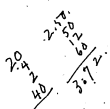
372.

2.16

250

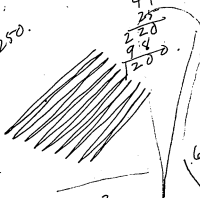
12.

6/66



450

250.



25

3

50

250

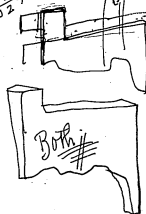
3.

600.

6.-

144

1600.



6

12

24

48

96

1

50

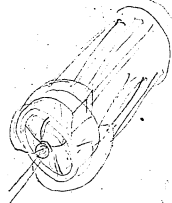
25

12

6

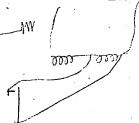
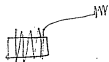
4.

Powr Cottons on parafine  
blox -



Hand-drawn sketch of a cylindrical component, possibly a lens or a cap, with a central circular feature and some internal lines.

Hand-drawn sketch of a cylindrical component, possibly a lens or a cap, with a central circular feature and some internal lines.



$\frac{1}{2}$  6 70.  
4000.

3.

20

$\frac{1}{4}$

40.

$\frac{1}{5}$

1000

10

20

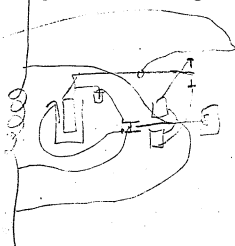
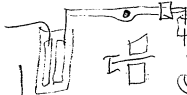
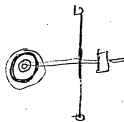
40

$\frac{1}{2}$



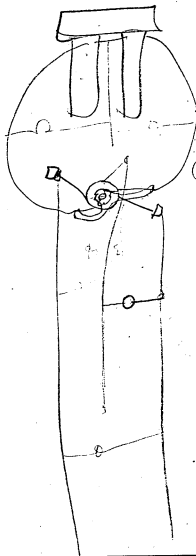
May 31. 1882

John F. O'H.

File  
Chas. D. Hughes

May 31. 1882

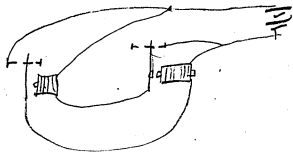
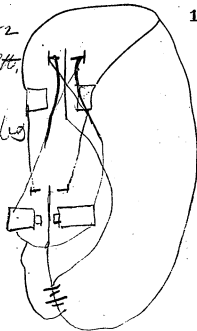
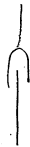
John F. O'H.

File  
Chas. D. Hughes

#12, 25-

May 31, 1882  
John F. Ott.

Chas. T. Hughes

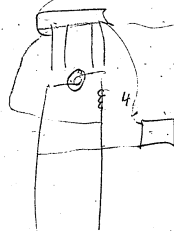
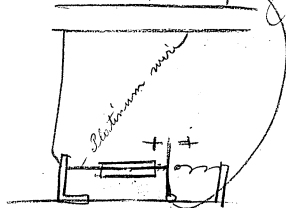


3.

May 31. 1882

John F. H. H.

Chas. F. Hughes

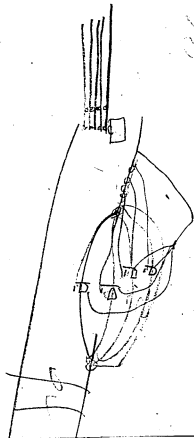


3-4.

4.

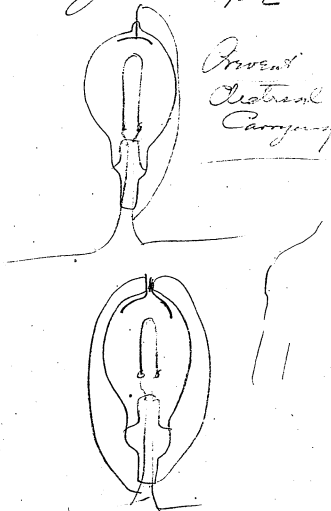
May 31. 1882

John, F. Otto.

1/4  
Chris. J. May



July 5 1892  
TAE



24 30 Lamps 11 less 1/2 bet,



Lamp  
35 = 12 strokes 50  
35 12 51 10

40 12 40  
39  
39 5

45 34  
34  
34 5

50 29  
29 2

55 27  
27 3

60 24  
24

65 21  
21 3

70 19  
19 2

Curve on dash  
got magnet meter  
with Beam

FAE

July 5 1882

John S. Galt.

1000. 975

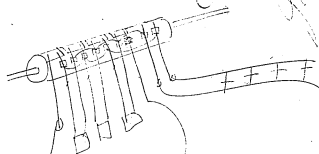
75

90. 100

Chas. C. Kunkle

June 17 1882

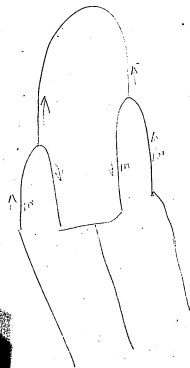
17. 61



M. C. G.







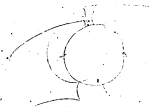
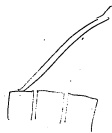
June 12 1882  
709

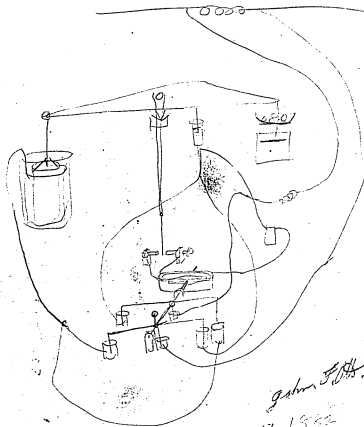


sticks from glass  
on by oxidizing  
oil, Japan Varnish

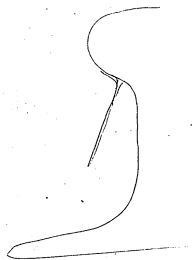


in the ammonia or  
Cellulose or Nitro  
Cellulose in Nitro Benzol  
or Nitro the ends of  
the loop & then  
click with a Saline





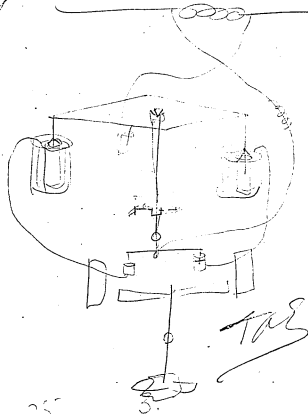
John F. H.  
June 12 1882  
EE





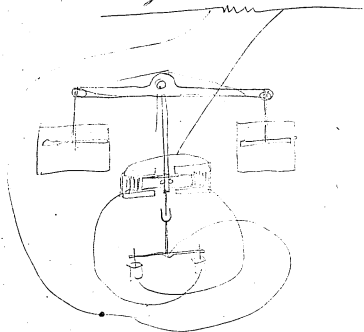
June 12, 1852  
John F. Pitt

John F. O'H.

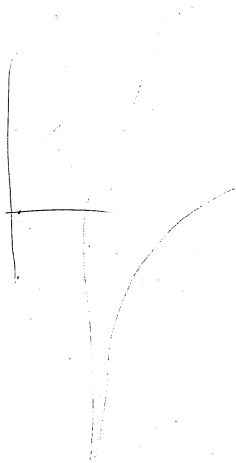


June 12. 1882

John F. Hitt.



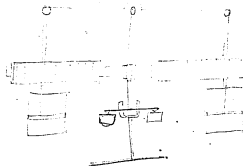
J.F.H.



June 12, 1882

John F. L. H.

ARE





June 29 1882

*John F. O'Keefe*

*John F. O'Keefe*

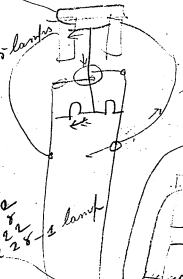
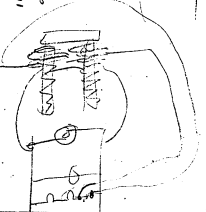
Tested  
June 29  
Def

10 Bell gave up 14 1/2  
one cell 1049

170  
175  
178  
182  
184  
191  
196  
201  
206  
212  
218  
222  
228

55 lamps

1 lamp





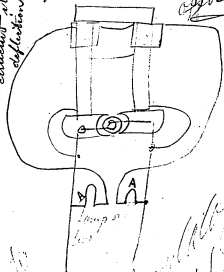
Lamp System

W. H. S. Co.  
S. H. S. Co.  
S. H. S. Co.

With lamp marked A in  
current it gave the following  
deflections

| Lamps | Def |
|-------|-----|
| 45    | 170 |
| 40    | 171 |
| 35    | 175 |
| 30    | 182 |
| 25    | 188 |
| 20    | 194 |
| 15    | 200 |
| 10    | 205 |
| 5     | 210 |

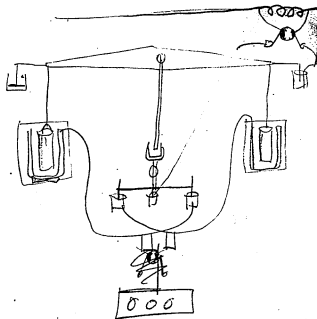
July 12, 1882



exposing oil

Automatic  
Lamp  
System

Automatic Lamp System  
John F. H.



John O'Hane Kinsade  
 July 3 1882  
 J.F.O.

$$450 \overline{) 1350} (3$$

$$450 \overline{) 2375} (5$$

$$\begin{array}{r} 450 \\ 225 \\ 1350 \\ 500 \\ \hline 2375 \end{array}$$

$$\begin{array}{r} 250 \\ 160 \\ \hline 150 \\ 250 \\ \hline 400 \end{array}$$

10

3

$$\begin{array}{r} 2 \\ 1350 \\ 250 \end{array}$$

$$450 \times 100$$

16

160

$$160 \overline{) 500} (3$$

~~30~~2<sup>+</sup> 3

$$\begin{array}{r} 35 \\ 300 \\ \hline 70500 \end{array}$$

\$10000

45

24



250

14

10

 $9\frac{1}{2}$ 

$$\begin{array}{r} 950 \\ 3 \\ \hline 2850 \end{array}$$

12

36 to 28.50.

7

$$36 \overline{) 250} \quad 7 \text{ to inch}$$

$$\begin{array}{r} 36 \\ 9 \\ \hline 324 \end{array}$$

$$\begin{array}{r} 28 \\ 3 \\ \hline 250 \\ 253 \end{array} \quad 9.$$

325

$$\begin{array}{r} 1950 \\ 325 \\ \hline 520 \end{array}$$

Continuation of Experiment  
on page 49.

Connected 4 lights in Muhl arc  
it gave lower candle power, but  
increased in candle power some  
raise as the other.

July 12. 1882

John F. C. H.

Has tried pressure Magnet  
in Muhl arc. when pressure became  
to high it closed points that  
closed single point sounder, closing  
second winding across Muhl arc  
with Main lines. I found that  
it almost required the same  
energy to bring the Magnet down  
as it took to build it up.

The two pairs on each core measured  
5.4 ohms, and I found it necessary  
to short circuit this to bring  
the lights to a dull red

Magnet Grand dashpot

3500 35.

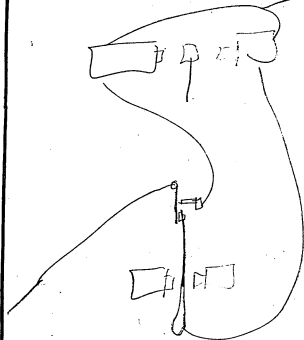
10000

4.

400

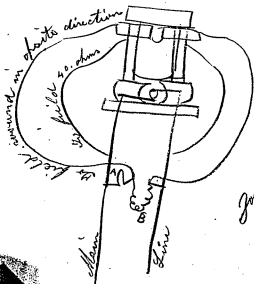
$$\frac{1}{100}$$

$$\begin{array}{r} 2500 \\ 3500 \\ \hline 1000 \end{array}$$

$$\begin{array}{r} 3500 \\ 2500 \\ \hline 1000 \\ 1750 \\ \hline 750 \\ 400 \overline{) 1750} \\ \underline{1600} \\ 150 \\ 400 \overline{) 1500} \\ \underline{1200} \\ 300 \\ 400 \overline{) 3000} \\ \underline{2800} \\ 200 \\ 400 \overline{) 2000} \\ \underline{1600} \\ 400 \end{array}$$


July 20, 1882

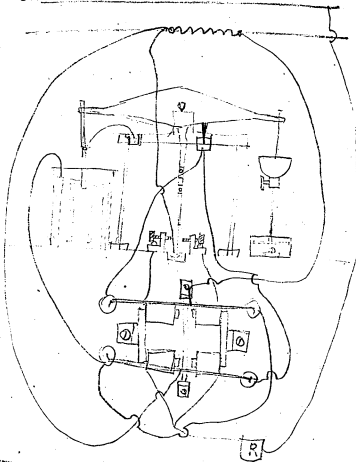
Tested the following connections  
as current regulator or pressure  
regulator A. represents group of  
bumps. B. Copper shunt or resistance.



John F. D.H.

\$960.73

~~968.70~~  
~~1785.88~~  
~~389.01~~  
~~2909~~

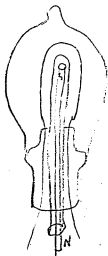


July 20. 1882

John F. Ott.

Tested Weber meter and found  
that the mercury changed its resist-  
ance while working, so much as to give one  
half the reading, after working, half  
day, under the same condition, or in  
other words some number lamps some  
pressure

John F. Ott.



Mar 8 1883

Tat

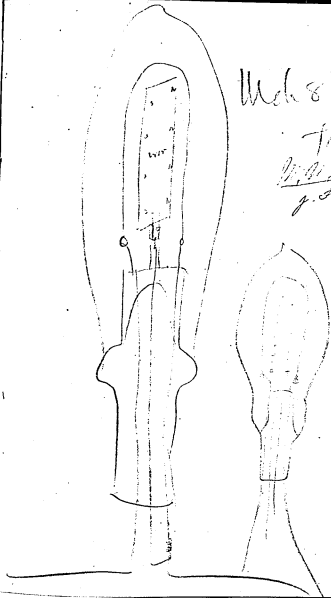
M, M, F

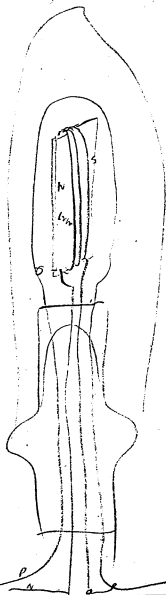
beam magnet  
piece of compass

75-

Mch 8 1883

719  
M. G. F.  
 J. F. O.





Mch 8/1883  
 Tag  
 M. A. F.  
 J. F. O.

P  
 a



Lamps Mch 8 1883 - Tag 71  
 passed thread through  
 baganuth & die -

Made lamp with P. terminals  
 large surface ditto  
 N - ditto 60th A.T.P. dont  
 see much change regular

Have ascertained that the  
 of one of the plates in wire  
 in inside part is due to  
 electrolysis & conductivity  
 of the glass - & that fine  
 glass has less & smooth  
 glass still less than  
 our regular lead glass  
 and greatly makes over bulk  
 of these glasses Tag

Meck 8 188390E

Have ascertained that <sup>findings</sup>  
ends in Carbon can be only  
done with <sup>by the</sup> use of a Carbohydrate  
Cement = No Hydrocarbon  
will answer as well -

am trying lot experiments  
get sample indicating  
meter electric test used  
with Hg & Hg display  
of soil - It is apparently  
difficult

May 87 883 JAL  
 Reading Principles and  
 Loc there is a great  
 need of process of  
 compressing Brain —

I propose due this  
 mechanical process will  
 Brain from which the  
 air is exhausted (10)  
 the Brain is contained  
 the Brain — the will  
 allow it to cook —

---

Miter Mch 8 1883 92877

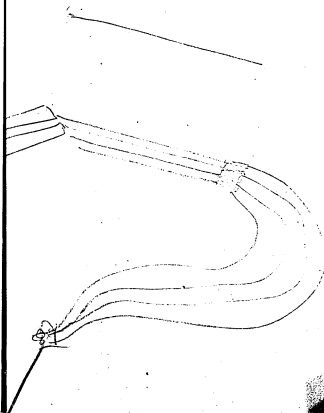
5 4 4 2.00



amalgamated Zinc  
was in test tube  
deposited on one side  
taken for 5 min.  
until it became

Each drop breaks at  
certain H<sub>2</sub>O temp.

Known as Electrolysis of water  
replaces a second cell  
in cell + destruction of  
cells mean certain Bell  
for dry cell.



10  
3  
3  
4  
3  
2  
2

250,  
10  
2500

30,000

45000  
600,000

12

20,000

75

4

15

1500  
50  
75000

247

520000  
520000  
520000

20

1500  
20  
30000

64

4

10

1200  
930  
10500

70

64

5

21



9300

6000

15300

1200

16500

2800

5000

300

2404

8

70

4

10

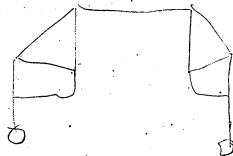
4

40

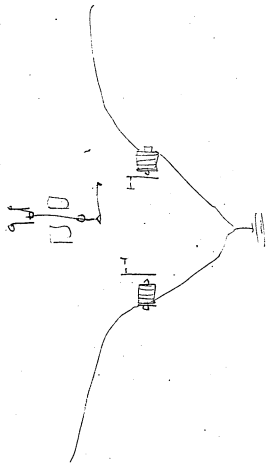
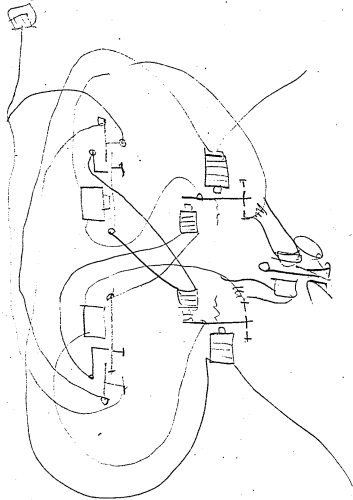
4500

4800

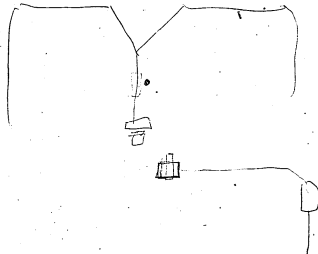
93000

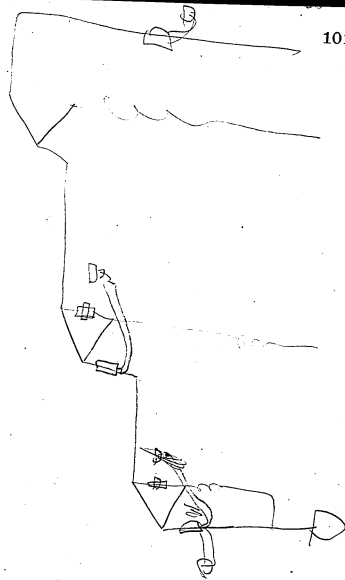


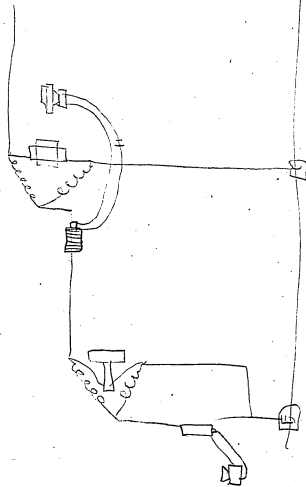
*Washington*

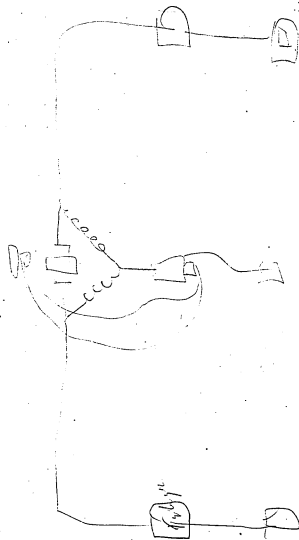






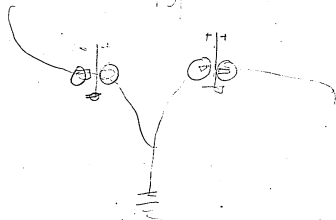


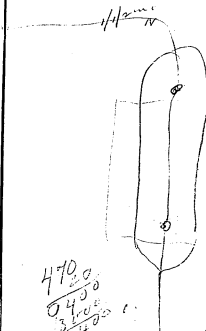






11  
13/8



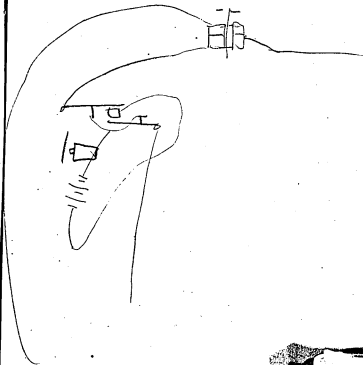
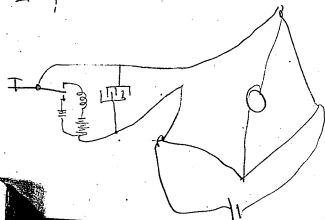
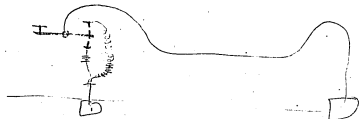
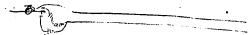


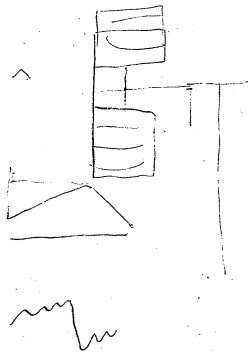
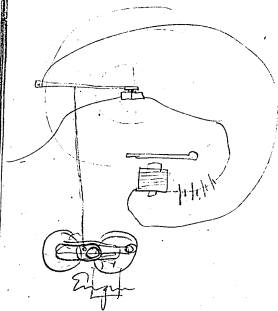
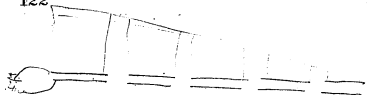
470  
 0400  
 3100  
 12400  
 86000

Pelion on Osea  
 3075

1000  
 500  
 375  
 600  
 100  
 500

1 1/2 m 75  
 36  
 4  
 60







124 13

68

53

42

—



125

$$\begin{array}{r}
 1342 \\
 1341 \\
 \hline
 2882
 \end{array}$$

$$\begin{array}{r}
 383 \\
 69
 \end{array}$$

$$\begin{array}{r}
 11 \\
 48 \\
 99
 \end{array}$$

$$\begin{array}{r}
 94781 \\
 4781
 \end{array}$$

$$\begin{array}{r}
 19462
 \end{array}$$

5

$$\begin{array}{r}
 16 \\
 16
 \end{array}$$

$$\begin{array}{r}
 2 \\
 2
 \end{array}$$

$$\begin{array}{r}
 4444 \\
 4444 \\
 4444 \\
 4444
 \end{array}$$

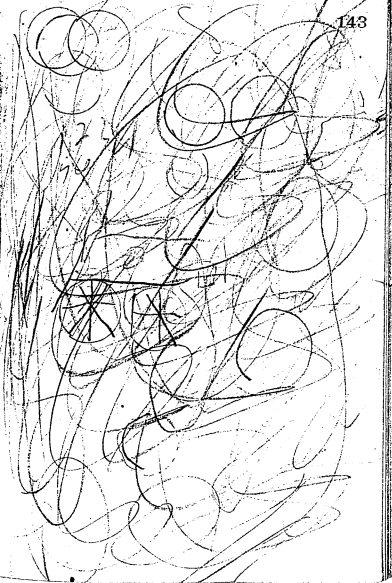
2 2 2 2  
 5/8 30  
 36 5 7  
 12 4 5 6 4 6 9

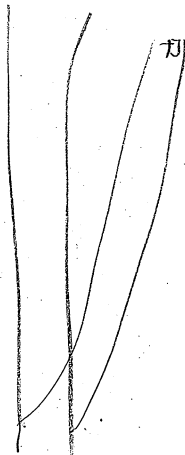
2 2 2 2  
 2 2 2 2

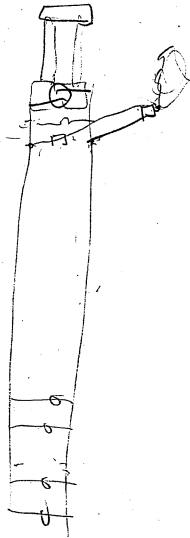
142

5000

143







110 10 1000 1000 5500

110 1000 5500

20

20 1000 90000 100

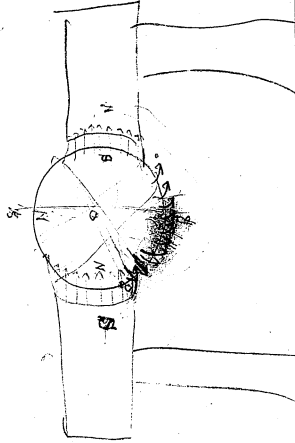
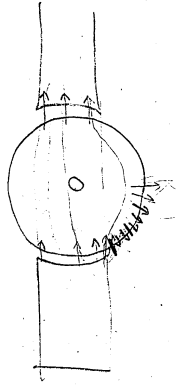
110 1000 5500

1000 10000 80000

20 2000 55000 100

55000 1000 605000 100

90000 1000 80000





90 100 100  
 '01 '01  
 5. 5.00

$\frac{500}{2500}$   $\frac{100}{102} / 10000$   $\frac{20}{102} / 2000$   
 $\frac{10}{102} / 500$

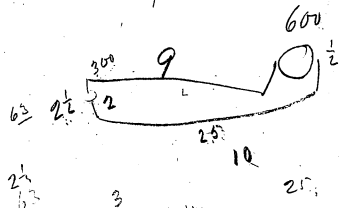
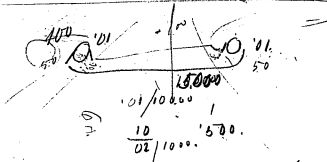
90  
 5000  
 746 / 4576 | 60

00

100 100  
 100 100

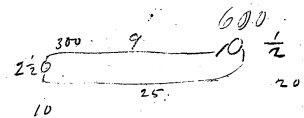


2 1/2 - 9. — 600 1/2  
 25

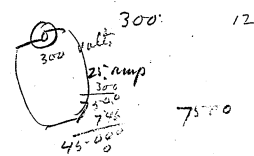


$$\frac{600}{50} \div \frac{655}{655} \quad 300.$$

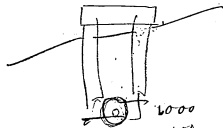
$$\begin{array}{r} 63 \\ 25 \\ \hline 1515 \\ 125 \\ \hline 1595 \end{array}$$



$$\frac{62}{25} \times 25 = \frac{25 \times 300}{7500}$$

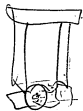


7500



6000  
500

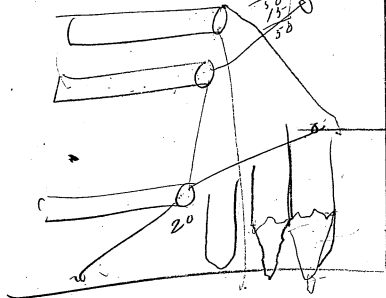
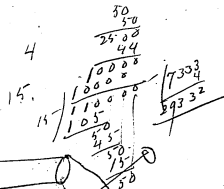
1000



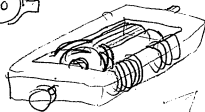
425

950

100



4



10 inch  
4 dia.  
8



150  
16  
90  
140  
24

240.

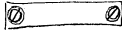
240.

240) 900  
720  
180  
1640  
13200



9) 150  
27  
147

21 1/2 240) 500  
480  
20  
23



238.

April 1 1885

Jar

Have Lamp Co cartons some  
plates of  $\frac{1}{2} + \frac{1}{2}$  mixture oxide  
manganese precip + hard carbon  
with Tar ~~as~~ as binder plates  
for Storage

also some porous plate Carbon  
made with Tar, hard Carbon +  
baking soda

See if pure black Tin  
Monoxide is conductor

Try for exp of air sulphur  
Tin

April 1 1885

239

Jar

beam of

Cylinder



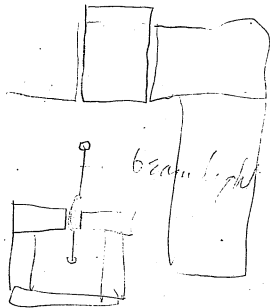
beam of

Copper wire coated  
around it like same as  
I



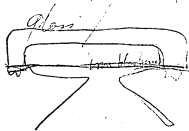
Beam changes surface rubber  
statistically copper band it  
was taken it up gave  
Reverse currents with telephone

April 1 1883  
Took



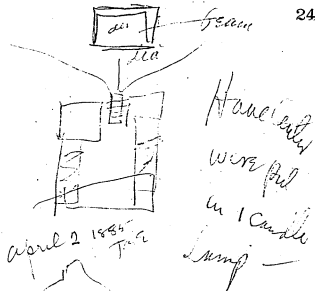
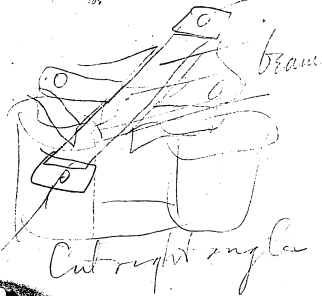
Rubber suspension  
Vibrates coil by  
Expansion

April 1 1883  
Took  
beam light  
vibrates  
expansion



beam light  
Hard Rubber

April 2<sup>nd</sup>  
1885



try to get from  
we hope  
also magnet  
also something  
see in ed. d. m. s.  
Carrying forward

April 2 1884

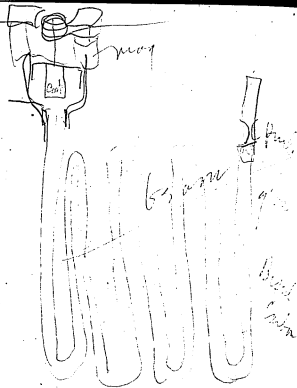
Tar

get some luminous  
 paint. put inside  
 globe & exhaust  
 high vac. see  
 if sensitive to green  
 also if the discharge  
 make a luminous  
 so make for green  
 watch chain see  
 time day night

Look up all the colored  
 salts that are in flat  
 scales like plantago &  
 try compression & mixture  
 with clay like red lead  
 pencils  
 Red & blue needed  
 also try Bronze for  
 pencils

April 2 1884  
 Tar



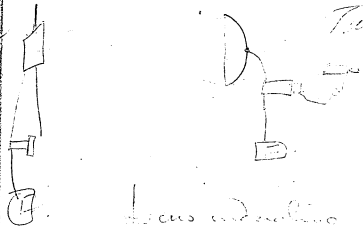


or liquid crystal expansion

April 2, 1964  
TCR

April 2, 1964

TCR

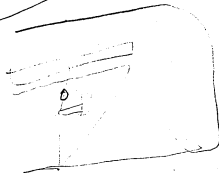
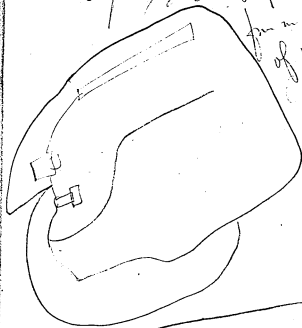


focus indicating  
Committee if it  
will go as a beam

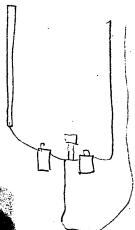
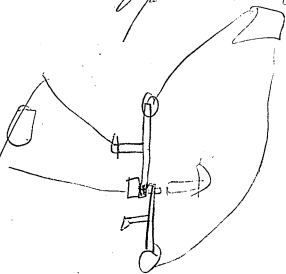
Quand cable

april 2nd  
1885  
for

wire

unemployment  
97044April 2 1885  
fortry self driving  
for mag instead  
of induction  
coil -

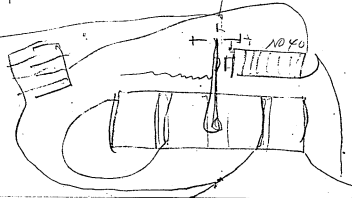
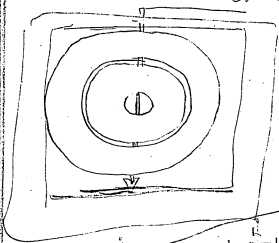
April 3rd 1886  
Toll



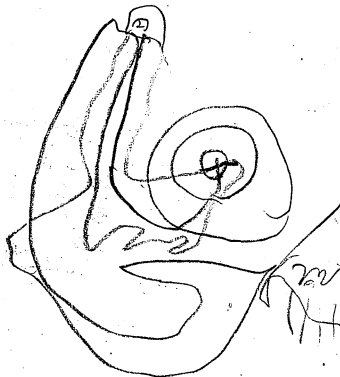
W  
r

April 3rd  
1886 Toll

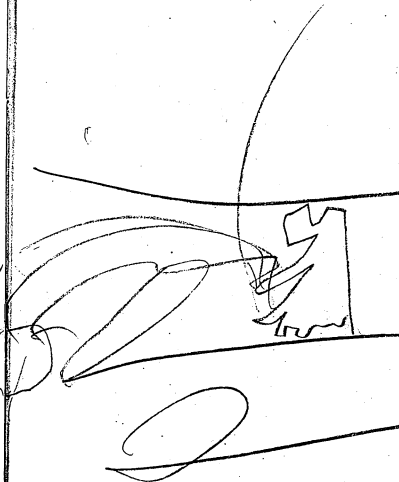
Sextuplex relay  
Coils only



252



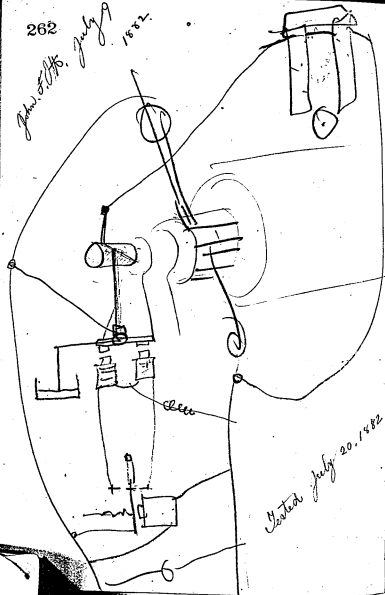
253



25

6  
5  
R  
B  
P  
A  
A  
A

John. F. H. July 9 1882.



Tested July 20. 1882

Tested regulator on page 262 and found that brake and brush burn out very fast and also regulated by jerks keeping a constant rise and fall to the lights. This cause was not due to imperfect workmanship, but to natural causes

264

264

~~264~~

265

Q. 10 V. C. 9

12345

12

13

14

15

23

121

12

234

231

345

23

24

21

34

35



$$\begin{array}{r} 2110 - 210 \text{ G/o} \\ \hline 110 \\ \hline 110 - 10\% \end{array}$$

$$\begin{array}{r} 130000 \\ 90000 \end{array}$$

$$\underline{35-000}$$

$$25700$$

$$2900$$

$$\begin{array}{r} \neq 1450 \\ 844 \\ \hline 2294 \end{array}$$

$$2900$$

$$8\%$$

$$\begin{array}{r} 23200 \\ 1450 \\ \hline 20)24650 \\ \underline{1232.2} \\ 1416 \\ 2648 - \\ 2294 \\ \hline 354 \end{array}$$

$$1666$$

$$17$$

$$11662$$

$$1666$$

$$20)2232$$

$$1416$$

30,000 10/-

35,000

15000 20

500000

12

35... / 36.00000

12) 103

4.7 8/6

10000

80/-

20) 85000

42

4.25

2500

750

583

29.15

235.

forre  
B.H.

Menlo Park Notebook #206 [N-81-03-09]

This notebook covers the periods March-April 1881, August 1882, and January 1883. All of the entries are by Edison. Some of the entries were witnessed by John Ott. Most of the material relates to electric lighting. Included are notes and drawings of automatic voltage regulators, electric meters, dynamos, conductors, distribution systems, and chemically treated filaments. Included also are notes from various works on chemistry and drawings of telephone devices. The book contains 276 numbered pages. The last few pages have been torn out of the book.

Blank pages not filmed: 22-23, 36-39, 148-149, 152-155, 166-167, 172-173, 176-177, 182-183, 188-192, 197-203, 230-247, 250-275.

Missing page numbers: 157-158, 163-164, 185-186, 193-196, 207-208, 211-216.

LIBRARY OF THE  
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

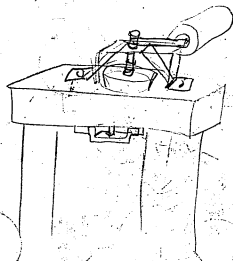
*From Library*

*44 Broad St. N.Y.*

*May 1, 1896*

1

*Wch 9 1881*  
*Tag*

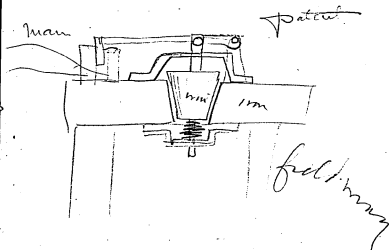
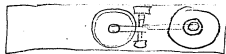


March 9 1881

TAE

g 5.0

Auto Reg

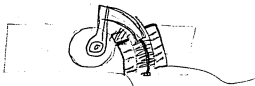


March 9 1881

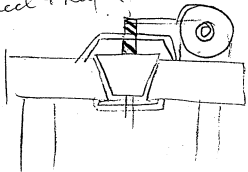
Auto Reg

TAE

Patent 7.50

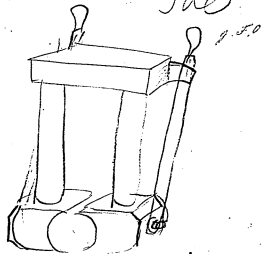


Can have a hand  
wheel & Reg 9.11 hand 2 1/2 in



use this for prime field mach  
to work other fields also for isolated

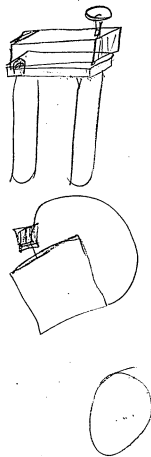
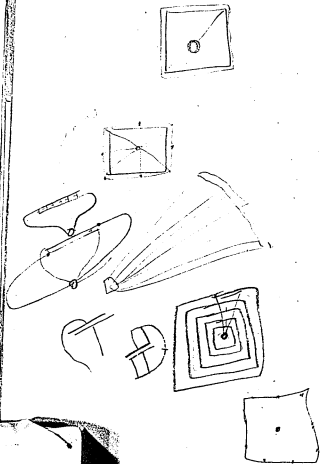
March 9 1881  
JAE



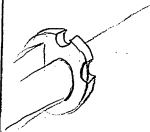
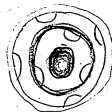
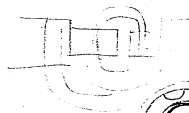
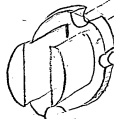
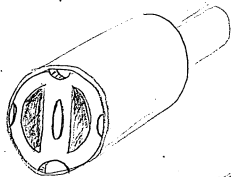
~~Auto~~ Regulation



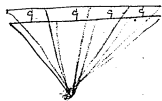
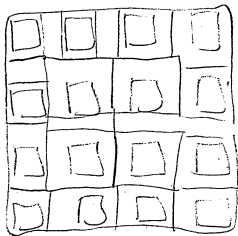




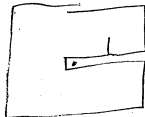
Mich 9 1881  
TAS



Mich 9 1881

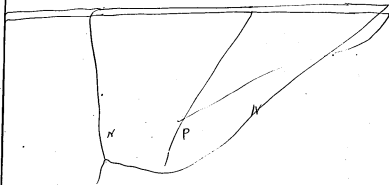


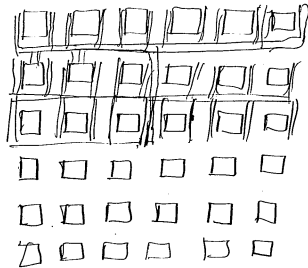
March 9 1881  
T.C.C.



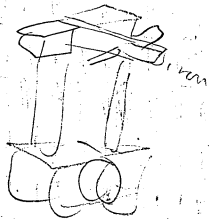
Forrestia  
Forrestia

Moh 9 1881 Tae



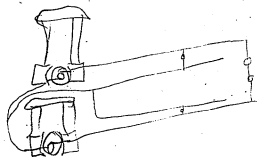
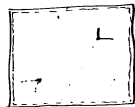


Distribution  
Mch 9 1881  
JRS



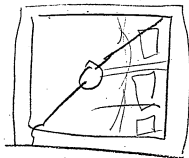
Wch 10-1551

- PSE

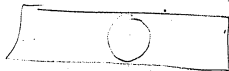
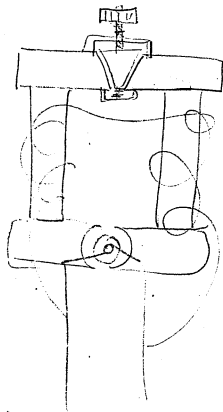


[ITEM FOUND IN BOOK]

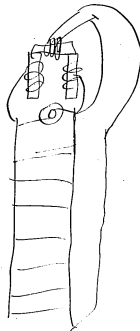
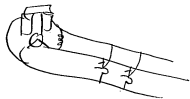
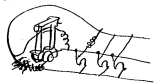
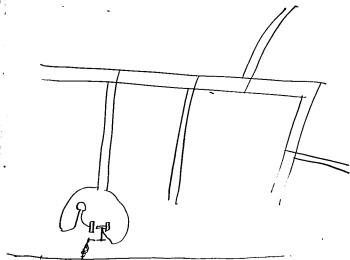
3-wire system 3/10/81 (?)



Mich 9 1881  
Tür



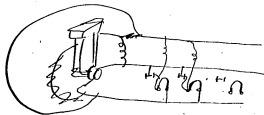




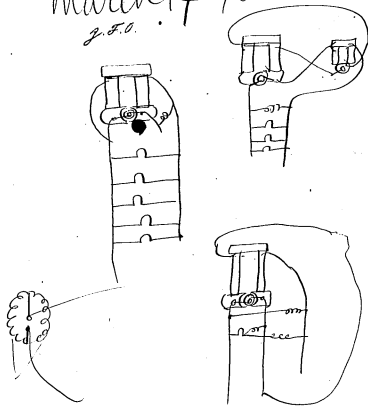
March 14. 1881  
TCE

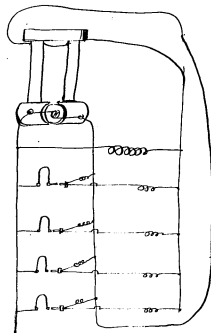
5 / 2.50

1500,



March 14 1881 <sup>29</sup> ~~Jan~~  
J.F.O.





March 14 1881 Matt  
for patent J. E.  
J. E.

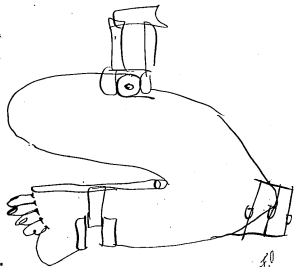
750 feet,  
396-lamp.



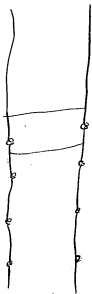
193

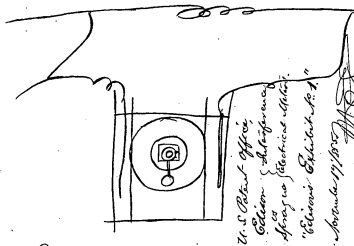
193

157 lbs;



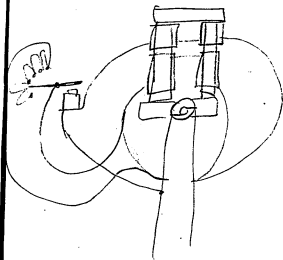
April 3 1961  
 TAE 9:50  
 Supply  
 for component





Copper cylinder revolving in a  
Sulphate Copper Solution, with a  
weighted counter within it so that  
when cylinder revolves counter  
will be still, deposit of Cu  
on one side & taken off the

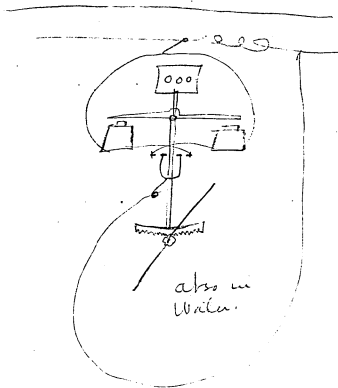
April 3 1881 TAG  
J.S.B.



Auto Regulation  
April 3 1981 TCS

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J.F.O

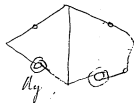
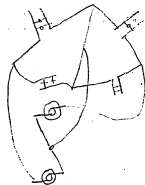


April 3 1881

TAE  
2.00



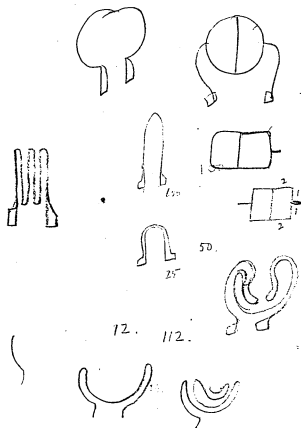
April 3/1887  
Jas

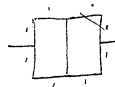


Matt for the

April 5 1887  
JAS

Arlo Cutoff-




$$\begin{array}{r|l} 4 & 2 \\ 4 & \end{array}$$


9-

54

12

6—

6-

2

21

6—

5

81

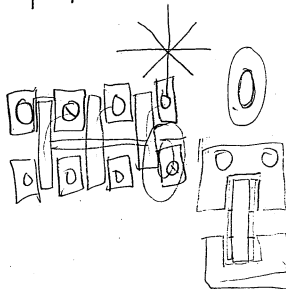
4-10

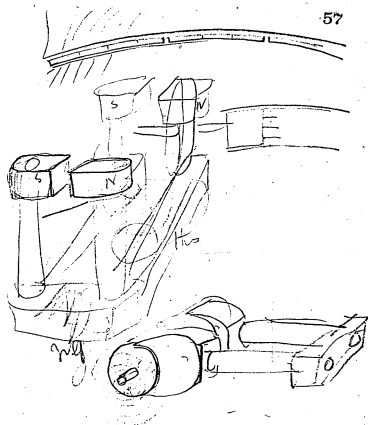
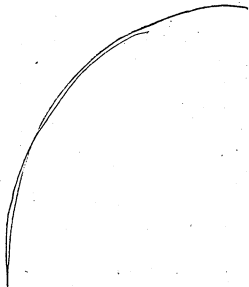
April 14

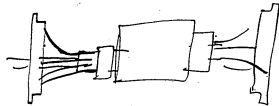
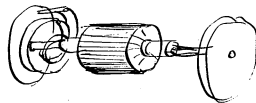
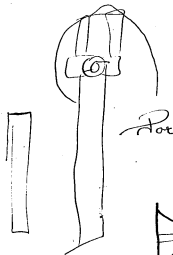
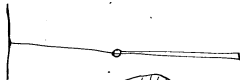
Dynamo

1884

1 1 1 1 1 1 1 1 1





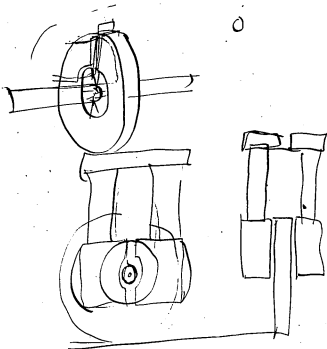


10

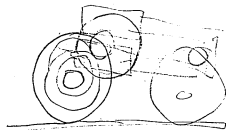
$$\begin{array}{r} 120 \\ 100 \\ \hline 2,000 \end{array}$$

4000.

0







Aug 1 1882

Tas

Lamp Experiments -

Use Coconut charcoal platinized  
by soaking 5 minutes in boiling  
solution Bichloride platinum then  
igniting in plat crucible or holding  
in flame spirit lamp, put it in  
lamp hat + pump out quickly

Zinc Ethyl and Sodium Ethyl  
mixed  
instantly absorbs CO: turns  
black = Wanklyn says deposit  
not Carbon as it dissolves in  
HCl. See J. Chem Soc  
p 13 Vol IV. No 19 -

Karsten. (see Wm. Milla 107-) <sup>67</sup>  
 say charcoal made from wet wood  
 has but 14 parts of the Carbon while  
 dry wood gave. from 33 pts 250 pts  
 Carbon but 100 parts wet only yielded  
 14 pts.

Charcoal charred by superheated  
 Steam 536 Fahr. analyzed

|          |       |
|----------|-------|
| Carbon   | 71.42 |
| Hydrogen | 4.83- |
| Oxygen   | 22.91 |
| ash      | 0.82  |

Schoubein found that ferric salts reduced  
 in cold by agitating the solution  
 with charcoal powder & mercuric  
 are reduced to mercurous salts

Berthollet has proved that by  
intensely igniting charcoal by the  
Voltaic arc in a current of  
pure Hydrogen that Acetylene  
 $C_2H_2$  is formed

Try lighting a lamp in  
pure dry Carbonic acid  
to see how long it stands  
also exhausted, in which  
Carbonic acid is the residual  
gas = ditto try these  
two Expts with pure dry  
Carbonic Oxide CO.

The residual gas of our lamps  
is Carbonic acid from the  
lungs of the glass blower

Carbonic anhydride is not decomposed by heating with Sulphur or Chlorine & the Halogens ditto. but if mixed with hydrogen & submitted to a high temp water & CO produced =

Carbonic acid decomp by sparks or the silent discharge Making ~~CO~~ CO & O.

A solution of Cuprous Cl in HCl or a Cuprous salt in ammonia gradually absorbs CO is agitated with it but if liquid boiled most CO comes off

According to Bottlinger 73  
 Deut. Chem. Ges, Ber 1877 X 1122

CO readily absorbed large quantity  
 by well cooled dry Hydrocyanic  
 acid,

CO unites with Potassium if  
 latter heated to 176 Fahr  
 this is frequently employed in  
 gas analysis -

CO unites with equal vol  
 Chlorine in sunlight forming  
 Carbonic oxydichloride,  $\text{phosgene gas}$

CO Enters directly combn with <sup>75</sup>  
 Palassic hydrate when heated  
 with it forms formate.

Chlor<sup>74</sup> Silver in powder exposed to  
 dry ammoniacal gas rapidly  
 absorbed - the Chloride increases  
 $\frac{1}{2}$  in weight. does this at ordinary  
 temperature - by heating can be  
 driven out & condensed by ice  
 in another part of tube

Electric Spark discharge  
 ammonia 1 → 2 nitrogen 6 Hydrogen

Chlorine dec ammonia at ordinary  
 temp. liberating N & forming  
 certain circumstances Chloride Nitrogen

Nitrogen Combined with finely  
divided Boron at red heat  
also 1 pt anhydrous Borax + 2  
pts Chl Ammonia at red heat  
gives nitride Boron, which is  
white powder, feels like  
talc & not attacked by heating  
in either H or Cl.

I think pentachloride phosphorus  
is even better than phos anhydride  
as when heated to ~~200~~ high  
temp it decomps to  
phos anhy + free chlorine  
See Miller 295 - magazine



Mould up battons ☐  
 from our little mould  
 of following some hard &  
 some moderately hard

Phosphate Lime

Magnesia.

Alumina.

Silica

~~Hydrated~~ Ferric Oxide

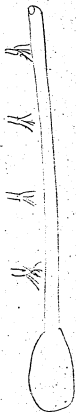
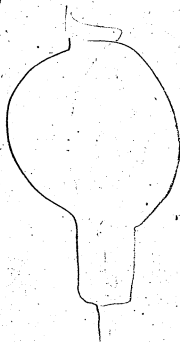
Gypsum

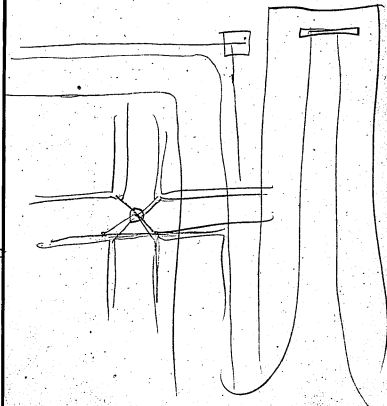
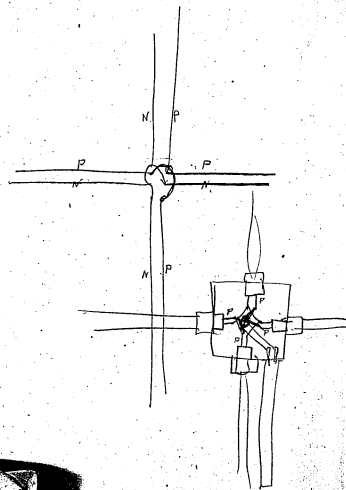
a piece of freshly burned charcoal  
 exposed to low condensation moisture  
 rapidly so in 3 days increases weight  
 2  
 3

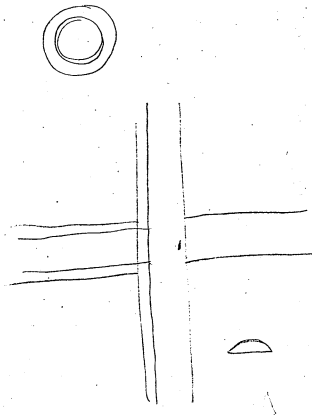
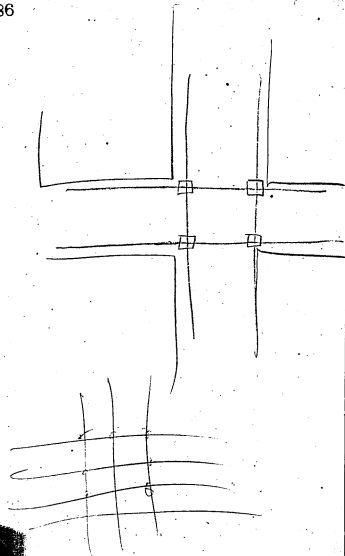
Spongy palladium absorbs 686 81  
 Volume of Hydrogen but  
 exhibits no tendency to absorb  
 Nitrogen or Oxygen

Gypsum

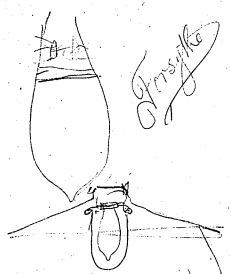
Graham - see Miller physics  
 p 120 - states that Soft  
 rubber lets in O & scarcely  
 any N. hence on pump  
 residual after while be  
 Entirely O. a square  
 meter of surface of  
 rubber at Sprengel let  
 at 20° 2.25 - Cub Centims  
 per min. of which 42 pc was O.  
 Continued to p. 9







$$\begin{array}{r}
 12 \\
 12 \\
 48 \\
 \hline
 72
 \end{array}
 \quad
 \begin{array}{r}
 24 \\
 64 \overline{) 324}
 \end{array}
 \quad
 \begin{array}{r}
 8 \\
 16 \\
 32 \\
 \hline
 80
 \end{array}
 \quad
 \begin{array}{r}
 72 \\
 72 \\
 \hline
 144 \\
 504 \\
 \hline
 324
 \end{array}
 \quad
 \begin{array}{r}
 16 \\
 32 \\
 64 \\
 \hline
 160
 \end{array}$$



*Forsythe*

2001 1001

Cooutehoué like Charcoal  
has power absorbing ~~the~~  
rapidly ammonia, Nitrous  
oxide, Sulphurous anhydride

See Graham's Experiments in  
his Chemistry + Phil Trans.  
1866, p 399. also 1863  
p 385

The gases are frequently  
reduced in bulk as much  
as would be needed for  
liquefaction -

Absorption by Caoutchouc Equal  
times was  $\text{CO}_2$  1 H 2.4 -  
O 5.13 air 11.8 CO 12  
N 13.5  
the number at 4 c. with only air passed through.

$\frac{1}{11}$  the velocity with which<sup>93</sup>  
it passed through at  $60^{\circ}$

Might try working sealing  
in plat wire by our  
process for freeing air  
as P takes 1.4 vols of  
H & retains it up to a  
red -

Copper takes up .3 to .6 its  
bulk of H.

For Secondary Battery Try red oxide of Hg  
Let's go to 0 by slight heat -

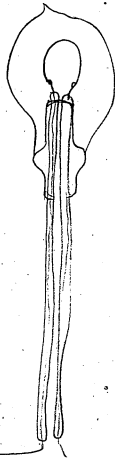
In form of sponge platinum absorbs  
1.48 its bulk while palladium sponge  
absorbs 90 vols Hydrogen



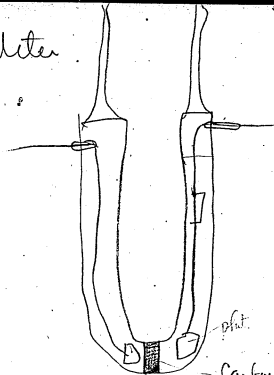
The blackening of one of the <sup>95</sup>  
 platina were ⑩ positive were  
 passing through the glass  
 is due to fact that there is a  
 constant spark here which  
 decomps CO to C & free  
 O. It is probable that  
 this spark also decomps some CO  
 in vac & deposit as glass.

The Hydrates of Sodium, Potassium  
 & phosph anhydride retain their  
 water at any temperature  
 hence in our experiments  
 use anhydrous K & Na by  
 burning the metal as well  
 as the dried Hydrates

Make an extraordinary long seal  
to get rid of that spark on p. plat  
wire that damps the CO.



Meter



Carbon from  
Cocoa, & other  
Compressed rubber  
membranes etc.

Electrolytic  
diff. of EMF.  
transference by

Bunsen says syrupy <sup>101</sup>Phos<sup>phoric</sup>  
and don't absorb gases

For preparing absorbent balls  
See p 53 Bunsens Gasometry

Fused Chloride Calcium absorbs  
Ammonia gas

Fused  $\text{K}_2\text{O}$ ,  $\text{CO}_2$  <sup>absorb</sup>

Bunsen used balls of phosphorus  
Cast <sup>under</sup> ~~in~~ water

absorption only occurs above  $15^\circ$  or  
 $20^\circ \text{C}$  if ethyl methyl ethyl  
or similar Hydrocarbon is  
present Phos must be heated  
nearly up to melting point  
before it absorbs O

if at commencement experiment  
Phos ball whitens then its  
1/2 if no cloud then no  
Phosphorous acid is formed

103

Tension Vapor phos-ous acid  
which coats walls. Considerable  
if not carefully dried (with  
ball potash Bunsen) think phos.  
anhydride best

Bunsen rather records Liebig's  
plan of absorbq with Ball of  
papa pulp moist & dried at  
100 C & saturated with a  
concentrated solution of  
pyrogallate. off glass it  
absorbs slowly but  
completely, particularly if Ball  
renewed, but this not immediate

with the small amount  $O^{105}$   
residual, everything must be  
well dried. The pyrogal of K  
is a thick syrupy solution,

to absorb  $CO_2$  the potash  
ball must contain so much  
 $H_2O$  that its soft nuff to  
receive impression from  
the nail & must be  
moistened externally with  
 $H_2O$  before using.

Sulphuretted H. absorbed by  
Coke ball Coaled with salt  
Sul Cu Lactate aq - Tartar Ematic  
or other salt decomposable by  
Sulphur H. Sul Cu in form ball  
or chromate Hg

absorb it slowly

Dry Binoxide Manganese  
or peroxide lead decamp

Sul H quickly + immediately  
but Bunsen says they are bad  
in gas analysis as they absorb  
large quantities gas being porous  
bodies, that's ok for us

Phosphoric acid balls made  
by dipping plat wire in  
red hot cooling sol of  
phosphoric acid

~~Binoxide mang can be~~

Ball pure caustic K manganate  
also absorbs Sulphuric H as  
well as  $\text{CO}_2$  immediately

HCP gas absorbed by ball

oxide Bismuth, oxide Zinc  
which form white moist when  
ignited in flame.

Sul Magnesia or Borax + especially  
Sul Soda answer extremely  
well balls formed by dipping  
wire in melted salts melted  
in their own  $H_2O$  of crystallization  
Specially good when small  
quantity HCP gas present  
Everything dried with phosphoric  
anhydride.



<sup>Bunsen</sup>  
 Carbonyl Oxide CO can be <sup>111</sup>  
 separated from Light Carburetted  
 H - Hydrogen, Nitrogen,  
 Carbonic acid etc by means of  
 a concentrated solution subchloride  
 of Copper by saturating ball of  
 paper pulp

Olefiand gas (Elayl) absorbed  
 Coke ball soaked Concentrated  
 (but still liquid) solution of  
 anhydrous Sul acid in  
 monohydrated Sul acid the  
 acid fumes which diffuse  
 through tubes are absorbed  
 by KO<sub>2</sub> fused.

Ditetryl gas (Telrylene) 113  
 Completely absorbed by fuming  $\text{SO}_3$  (a)

Aethyl same process Ent Bunsen

Plot black absorbs acetylene

When the vapor of any volatile  
 organic substance is forced to the  
 electric spark acetylene is  
 produced. ~~the~~ acetylene is  
 formed in reactions at very high  
 temperatures.

Berthelot an chem + P (4) XX  
 431

Shuster absorbed O  
 by heating electrically in  
 iron wire in vac -  
 Shuster also used metallos sodium  
 1874 - in vac tubes

Favre says denser <sup>Ch<sub>2</sub>F<sub>5</sub></sup>  
 dont absorb so much gas as  
 porous

MP v Wilder, Deut Chem Ges Ber  
 says acetylene treated electric  
 spark condensed to yellow  
 oily liquid which after time  
 turns brown no solvent can be  
 obtained

Wood Charcoal placed  
 in one end of sealed tube  
 heated by boiling H<sub>2</sub>O  
 & other in freezing liquid  
 & saturated with dry Chlorine  
 gives liquefied Chlorine condensed  
 out Volatile liquids like  
 Bromine hydrocyanic a. Carbon suboxide  
 Dioxide Sulphur Ether & alcohol  
 retained with tenacity nothing  
 condensed

Phosphorous either in Vacuum or <sup>117</sup>  
 $H_2$   $CO_2$   $ArH$  or marsh gas or  $N$   
 when exposed to Violet light it  
 volatilizes & then settles on side  
 glass in form Brown red substance  
 its supposed that either  $O$  or Water  
 decamp does this but Guelin  
 said precaution taken

Phosphoric Oxide absorbs  
 $O$  &  $Cl$  either dry or moist  
 phosphoric acid or Chloride phosph being  
 formed - When dry this Oxide  
 yellow & destitute taste or  
 smell -

Phosphorus shines from Oxidation  
 in highest vac - diminishes  
 as vacuum falls - The greater

the rarefaction the less <sup>119</sup>  
 it necessary to heat the P.  
 at atmospheric press temperature  
 must be  $20^{\circ}$

P. absorbs chl nitrous ox  
 Vapn hyponitric acid, Marsh gas  
 olefant gas or vapour Ether,  
 Alcohol, rock oil, turpentine  
 Eupion, Creosote & other volatile  
 oil. Because it forms a  
 compound with them

Chlorine combines with H to  
 form ~~anhydrous~~ hydrochloric  
 acid which is white - but  
 How about  $H_2O$  in damp - guess  
 white coating not then

Mercy absorbs the whole of  
the Chlorine

Cl combines with H by action  
Spark

Chl + CO, combine in bright  
light in few minutes. form  
phosgene gas  $\frac{1}{2}$  the Vol.  
its not decamp by the  
Elec spark. when mixed  
with with either O or H  
but when mixed with  $\frac{1}{2}$   
Vol O + equal Vol H it Explodes  
yielding HCl + CO<sub>2</sub>  
Potassium Causes entire  
disappearance of the gas

one portion absorbs the  $CO$  the other <sup>123</sup>  
 the  $O$  of the  $CO$  products  
 $CH_4$   $K_2O$  + Carbon

Phos sublimes but produces  
 no change in phosphorus  
 gas

Suboxide lead absorbs  
 $O$ . made by heating  
 glass tube - oil the  
 tube containing Oxalate  
 lead. Dr. H. has bottle =

Acetylene is the only Hydrocarbon that can be  
 prepared directly from its free elements  
 This occurs when the Electric arc passes  
 between Carbon poles in an atmosphere of  
 Hydrogen - It is formed from

nearly all organic Compounds at a 125°  
red heat occurs regularly in Coal gas  
it can be obtained from the latter in  
considerable quantities by incomplete  
Combustion

It is a colorless gas - on passing  
acetylene over heated Potassium  
H is set free & voluminous colorless  
Compounds formed (1)  $\text{CH}$ .  $\text{CNa}$   
 $\text{CNa}=\text{CNa}$  which are violently decomposed by  
water.

If gaseous mixture acetylene passed  
over an ammoniacal sol of Cuprous  
Chloride a red precipitate formed  
(Spore ball mould would answer)  
a strongly ammoniacal sol of argentic  
nitrate - white precip.

Acetylene is absorbed by Antimonious  
Chloride. precip.

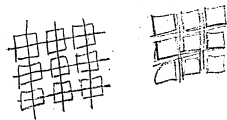
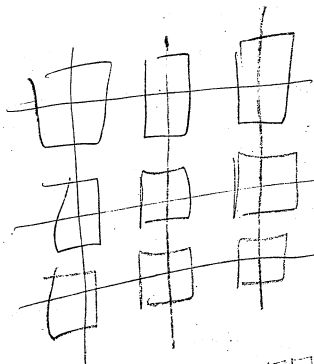


the drawing of the figure is the same as the figure in the preceding page. The figure is a square with a cross inside it. The cross is formed by two lines, one horizontal and one vertical, intersecting at the center of the square. The lines are drawn with a pen, and the square is drawn with a compass.

The figure is a square with a cross inside it. The cross is formed by two lines, one horizontal and one vertical, intersecting at the center of the square. The lines are drawn with a pen, and the square is drawn with a compass.

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The figure is a square with a cross inside it. The cross is formed by two lines, one horizontal and one vertical, intersecting at the center of the square. The lines are drawn with a pen, and the square is drawn with a compass.



Chlorine explodes when mixed with  $\text{H}_2$   
acetylene

Acetylene is absorbed by Cold  
Bromine

it unites with Iodine at  $100^\circ\text{C}$   
forming Crystals which melt at  $70^\circ\text{C}$

platinized asbestos produces  
slow combustion by absorbing  
the mineral was also -

Pumice stone & pipe clay are slower.  
they absorb the produced  $\text{CO}_2$

All seem to agree that  $\text{CO}$   
is readily absorbed by Cuprous  
Chloride in  $\text{HCl}$ .

$\text{CO} + \text{H}$  action by sparks  
after a long time gives an oily liquid  
which soon becomes amber color & on heating  
to  $100^\circ\text{C}$  becomes Brown it was

*[Faint, mostly illegible handwritten notes on page 130.]*

slightly soluble in  $H_2O$  giving  
yellow opalescent Sol having odor of  
Methylacetone mixed with formic acid  
it reduced mercuric oxide. (How about  
putting a reducing agent in walls of globe  
of lamp)

Cyanogen  $CH$  with Electric  
spark combine to form Hydrocyanic  
acid

Graham says  $CO$  rapidly absorbed  
by  $\times$  Sol of Subchl Cu in  $HCl$  or  
Ammonia, indeed by ammoniacal  
Sols of Cuprous Salts in general.  
The Sulphite  $\times$  it absorbs it as  
quickly as Potash does  $CO_2$   
deposit on glass may be  
paracyanogen - its black

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$\text{CO}_2$  is decomposed to <sup>133</sup>  
free O & CO. by electric  
spark

Nitric Acid acts on  
wood charcoal to  
form a soluble <sup>in  $\text{H}_2\text{O}$</sup>  block  
stuff -

Hydrogen & Nitrogen  
are very slightly absorbed  
by Coconut Charcoal  
Hunter = power to absorb  
diminishes with heat

Chromic anhydride combines with 135  
acetylene -  
wash bulb (12) I mean coat bulb  
with it =

CO may be oxidized to CO<sub>2</sub>  
by chromic acid introduce  
ball plastic jar soaked  
in Chromic Acid  
Concentrate highly - try  
drying it thoroughly also higher  
temp increases effect

Anhydrous Chromic A Combines  
directly with C according  
to Berthollet (don't believe)  
in Vac -

H is oxidized by chromic acid  
using plastic jar ball  
dry carbon might answer

here is table of ball 137  
with Chrome a in H

|              |      |
|--------------|------|
| original Val | 35.8 |
| 15 hours     | 29   |
| 19           | 27   |
| 26           | 23   |
| 65-          | 7    |
| 86           | 00   |

when the Chrome a is  
detrited Oxyd very slow

Ludwig record balls of  
plastic Paru when absorption  
agents are not fusible  
mixing with  $H_2O$  moulding  
in bullet mould made of  
which is oiled. The reason  
they coat with syrupy  
phos acid is prevent absorption  
gas mechanically (we want the)

Carbon monox uses ball  
 gypsum steeped mixture  
 1 Val saturated Chromic  
 a Sol & 2 Vals  $H_2O$   
 the  $CO_2$  must be absorbed by  
 Potash - The mould  
 must be oiled as Chromic a  
 attacks it

1 Val Coconut Charcoal oil  
 absorbs 4 of  $H$  & 15 of  $N$   
 - Hunder

Dry acetylene absorbed with  
 Evaluation heat by  
 antimony pentachloride =

Acetylene is formed by action  
 electric spark on many  
 hydrocarbons

Acetylene colorless gas  
 combines with Cl explosively in  
 diffused daylight & H<sub>2</sub> result  
 heavy oil

Acetylene forms metallic derivative  
 with fused potassium forms  
 black powder = perhaps K of  
 ash of bamboo works

Acetylene united with  
 copper form denoting  
 compound Acetylene  
 preserves moisture rapidly  
 attacks metallic copper



Acetylene is absorbed by 143  
Copper becomes coated with  
black substance, (probably low  
Vol blue before in dried air does it)

Naphthalene absorbs acetylene

Best Solvent Green Acetic &  
& absolute Alcohol.

Poorer Solvents Turpentine &  
Bisulphide of Carbon.

~~Bisulphide~~ of Carbon —

Bentham states acetylene  
only formed by arc not by  
induction spark. (perhaps when  
loop high in and it would)  
passage of induction spark  
through CO gives acetylene

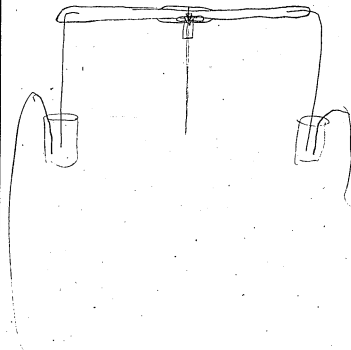
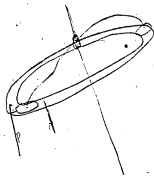
Cyanogen gas offers great  
resistance to spark

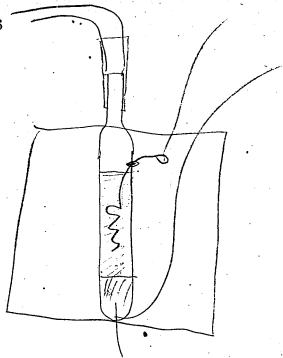
*[Faint, mostly illegible handwritten notes on page 144.]*

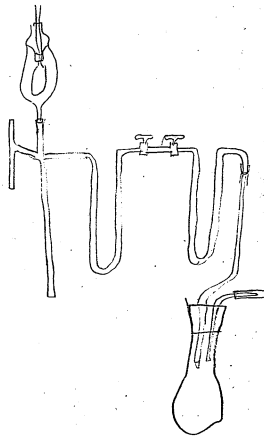
When Induction spark  
passes through Marsh gas  
tarry black hydrocarbons are  
deposited on tube =

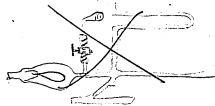
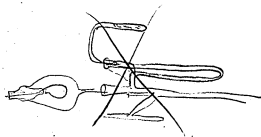
Acetylene is decomposed by  
Electric spark & deposits  
Charcoal Acetylene is  
formed in all organic  
Carbonizations =

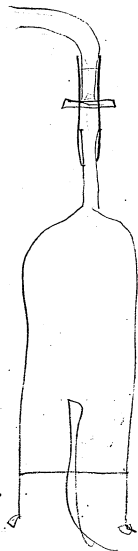
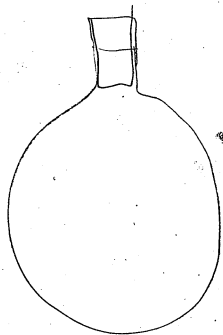
Send for metallic glass 147.  
 Subchloride Copper.



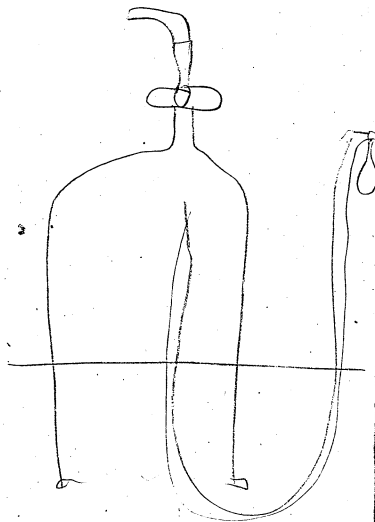


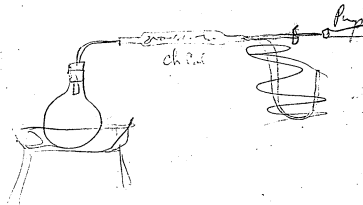
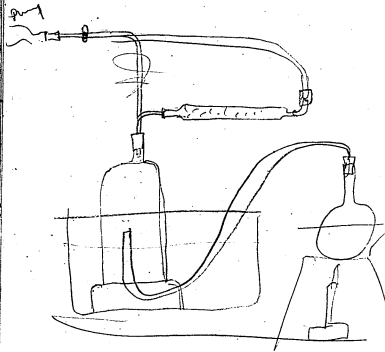


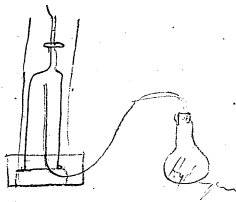




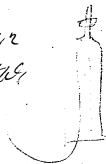


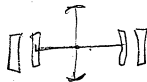
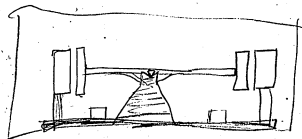


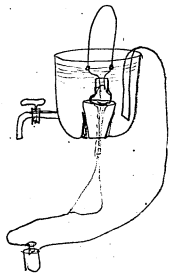




Aug 27 1882  
JCS



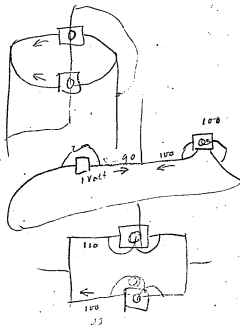




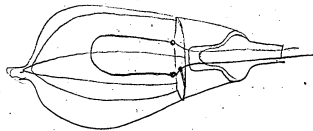
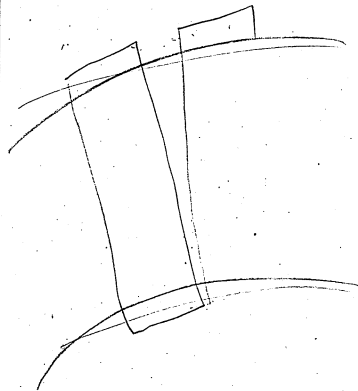
Aug 1882  
292 1/2

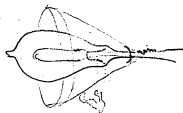
$$\begin{array}{r}
 12100 \\
 4 \overline{) 48400} \\
 \underline{48400} \\
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 5324000 \\
 \underline{5324000} \\
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 2324000 \\
 \underline{2324000} \\
 0000 \\
 2258000 \\
 \underline{2258000} \\
 0000 \\
 1108000 \\
 \underline{1108000} \\
 0000
 \end{array}$$

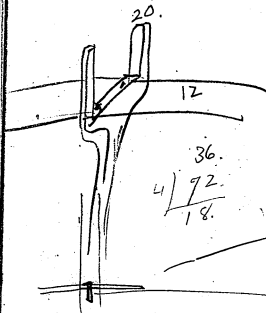
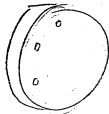
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 11000 \\
 \underline{11000} \\
 0000
 \end{array}$$



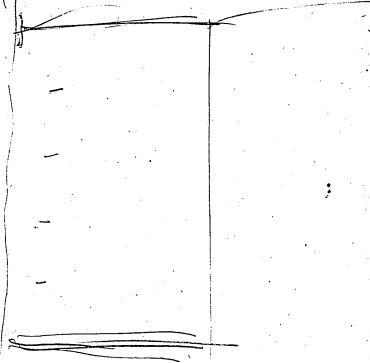
Aug 18 1882  
tes





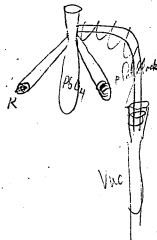
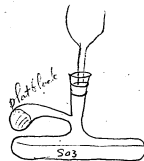
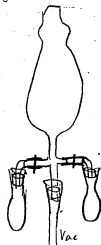


$$\begin{array}{r} 36. \\ 4 \overline{) 92} \\ \underline{18} \end{array}$$



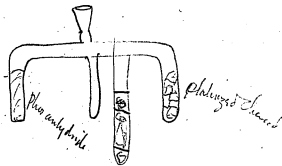
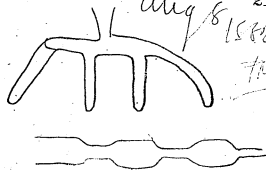


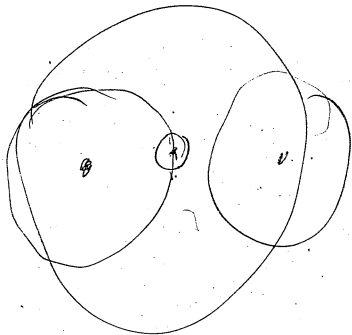
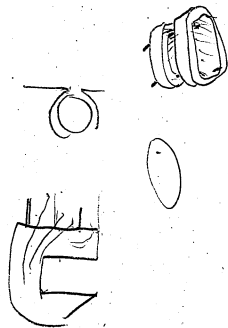
Aug 5/82 for

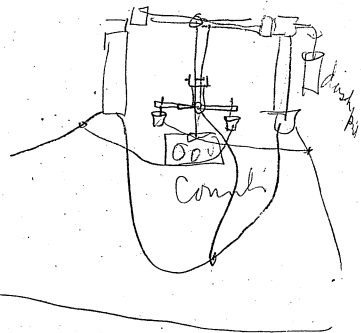


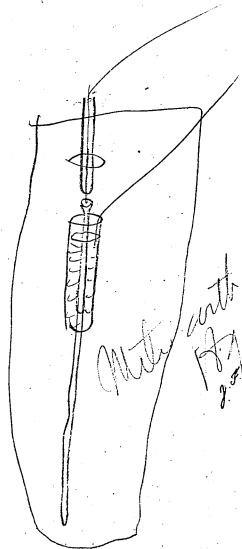
Aug 8/82

for



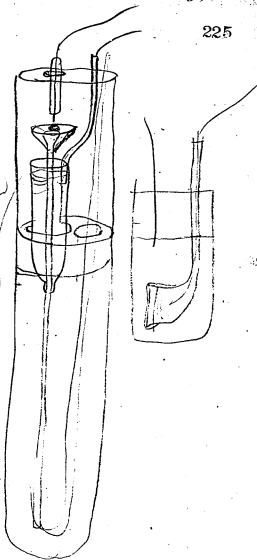


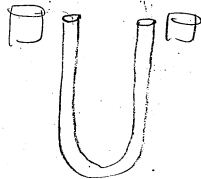




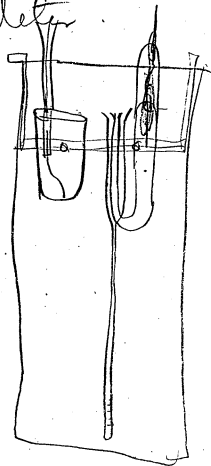
Mile with  
F.S.  
g.f.o.

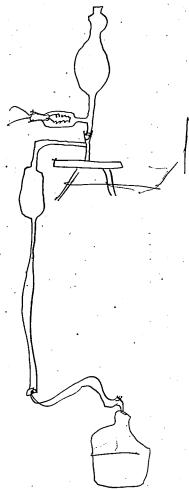
Mile  
with Hg  
July 20 1883  
Vax  
g.f.o.

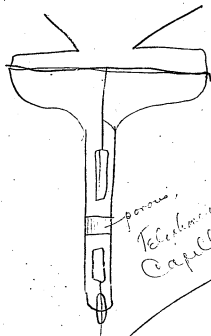




Meter







porous,  
Telecheminked by  
Capillary

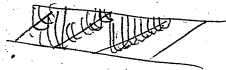
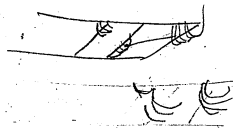
January  
20 1944

Ed. 11.7.12  
T.E.

703

276 Absorbing HCl gas -  
 Ballo ox Zinc  
 Bromuth

Melted balls Sul Soda melt.  
 then can water crystal.  
 Phosphoric anhydride must be  
 used as drier.



~~150~~  
~~8100~~  
 2500  
 7200  
 600  
 1000

$$150 \overline{) 2500} \begin{array}{r} 16 \\ 150 \\ \hline 1000 \\ 900 \\ \hline 100 \end{array}$$

~~400~~  
~~500~~  
~~300~~  
~~100~~  
~~100~~

$$\begin{array}{r} 31200 \\ \hline 31200 \end{array} \quad \begin{array}{r} 3000 \\ \hline 31200 \end{array} \quad \begin{array}{r} 6 \\ \hline 6 \end{array}$$

16.

$$\begin{array}{r} 35 \\ 3 \\ \hline 75 \end{array} \quad \begin{array}{r} 280 \\ 3 \\ \hline 840 \end{array} \quad \begin{array}{r} 16 \\ 8 \\ \hline 28 \end{array} \quad \begin{array}{r} 150 \\ 13 \\ \hline 450 \end{array} \quad \begin{array}{r} 150 \\ 150 \\ \hline 1950 \end{array}$$

$$140 \overline{) 840} \begin{array}{r} 6 \\ 840 \\ \hline 0 \end{array}$$

1.



**Menlo Park Notebook #210 [N-81-00-03]**

This notebook is undated but was probably used in 1881 or 1882. It contains notes by Edison relating to the geology of various states. Most of the material was copied from published geological surveys and other published works. The label on the front cover is marked "Magnetite etc" and "Iron Sand." The book contains 280 numbered pages.

Blank pages not filmed: 62-280.

Missing page numbers: 3-8.

*Magnolia, Sybilis 2*  
*" side of iron*

1

LIBRARY OF THE  
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

*From Library*  
GENERAL ELECTRIC.  
*44 Broad St. N.Y.*

*May 1*, 1896

Geological Survey State of  
New York 1840

Page 58 Clinton Co.

"The magnetic iron ore of this county  
are among the best in the state."

"The Arnold mine especially mentioned  
on account of quantity & quality"

Page 64 Essex County

"Enormous deposits of magnetic iron  
ore which are found in various  
parts of the County"

Page 66. Franklin County

"Magnetic iron ore, specular iron ore  
and bog iron ore."

## Page 69. Herkimer Co.

"Vein is from two to eight feet wide  
and has been traced about three  
quarters of a mile - highly magnetic  
and yields iron of good quality."  
Magnetic iron ore.

Page 71 Tioga County

"There is a valuable bed of magnetic  
ore in the southern part of the County."

Page 73 Lewis County

"Veins of magnetic iron ore are  
found in the primitive rocks on  
Moose and Black Rivers: extent  
and value has not been determined."  
"I have found magnetic iron sand  
on the banks of Moose River near  
Lyonsdale."

## Page 76 Momre Co.

"In addition to this magnetic iron,  
 "sand has been found in considerable  
 "abundance on the shores of Lake  
 "Ontario"

## Page 83 Orange Co.

"The important mineral product  
 "of this County is magnetic iron  
 "one of which there are vast beds  
 "situated chiefly in the town of  
 "Mornes"

"A bed of magnetic iron ore has  
 "been recently opened near the village  
 "of Canterbury" good quality  
 "Local situation"

## Page 84 Putnam Co.

"Contains several beds or veins of the  
 "magnetic kind, which yield one of  
 "the best quality and in the greatest  
 "abundance"

Same

Page 83 Ontario Co

"Magnetic iron sand is found  
"near Geneva". ✓

Page 93 St Lawrence Co

"The magnetic kind is found in  
"several places and is of a good  
"quality".

Page 100 Suffolk Co

"Magnetic iron sand and garnet  
"sand are found along the whole  
"sea shore".

Page 102 Warren Co.

"Limon ore there are in Warren County  
"Numerous and important localities  
"embracing both the magnetic oxide  
"and the hematite".

Same

Page 103 Washington les.

"Some on both of the magnetic and  
"ferromagnetic sands have been found  
"in it."

---

Geological Explorations of the  
"40<sup>th</sup> Parallel - 1877.

Page 18. Laramie Hills

"As accessory minerals there occur  
"magnetite, hematite" etc

Page 26. West side of Long Pass

"Magnetite in small irregular  
"particles was seen in a number of  
"localities." ✓

Page 108 Bush &amp; Cottonwood Cuts.

"The quartz is usually quite pure  
"accompanied occasionally by fine  
"particles of magnetite."

Same

Page 140 Park Range.

"As accessory minerals, garnet, magnetite and gold."

Geological Survey of Indiana etc.  
No. Minerals mentioned

Geological Reconnaissance in  
California 1858

Page 50 Near Castle Lake

Canyon de las Uvas.

"I found a mass of black ore which  
"attracts the needle strongly, and is  
"probably ordinary magnetite or  
"magnetite ore."

Page 289 Leavenworth Pass Uvas

"Magnetite iron ore occurs in a  
vein about three feet thick"



Same.

Page 289 Williams pass 21

"Large Rolled masses of magnetite  
 "were picked up in the bed of one of the  
 "streams entering the Valley of Williams  
 "pass on the east side".

Explorations in Utah 1859

Page 269. Ironore Rocks

"Particles of specular or magnetic  
 "iron ore a frequent occurrence  
 "in connection with the eruptive  
 "rocks of this district".

Page 323. Cedar City

"Superior magnetic iron ore occurs  
 "in the mountains near Cedar City".

Geology of California 60 to 64  
 Page 189. Canada de las Uvas  
 and Soledad Pass.

"Magnetic oxide of iron is also  
found in this vicinity"

Page 190. Base of the Canada de  
 las Uvas.

"irriguous metamorphic rock,  
containing magnetic oxide of iron"

Geology of Arkansas 1857 & 525

Page 217 Independence Co. (eastward)

"Very rich in iron ore but too much  
"mixed with sand to admit of  
"its being used profitably".

Geological Survey of the Territories  
1867, 1868 & 1869. Hayden - (Colorado)

Page 193 Colorado

"At the source of the Arkansas are  
"immense deposits of magnetic  
"iron ore in the metamorphic rocks".

Magnetic iron ore Las Vegas Mts. <sup>156</sup> 20.43

" " " " " " " " 65.27

U.S. Geological & Geographical  
Survey of Colorado and adjacent  
Territories - 1876. Hayden.

Page 122. Colorado

"Iron is found and mined, 23  
 "Colorado on Grape Creek near  
 "Canyon City." "The ore is magnetic  
 "the yielding a high percentage  
 "of the metal,"

Geological Survey of Montana  
 1872 Hayden -  
Makes no mention of Magnesian

Geological Survey of Wyoming  
 1871 Hayden -  
 Page 115 -

"In the bed of the Cheyenne river, and  
 "on the sides of the adjacent hills  
 "we found immense numbers of  
 "rounded black nodules of mag-  
 "netic iron ore which summed of  
 "unusual richness

Geological Survey of Ohio 29  
Newbury 1870.

Page 45. North eastern Ohio  
"and Black-Sand - as in the  
"Valley of the Little Beaver - is  
"introduced as another element  
"into this ferruginous belt."

Report of Statistics & Geology of  
the State of Indiana. 1879-1878-  
1876, 75-1874-1873-1871-1869-1880

All refer to slight and small  
deposits of iron in various sections  
but no sands or Magnetite.

Geological Survey of N. Carolina  
Kerr 1875

Page 317.

"The ore iron are very widely dis-  
tributed in this State, including

"Magnete, Hematite, Limonite  
"and Siderite"

Page 219 Ash Co

"It is often in ~~large quantities~~  
"quite large compact lumps of  
"a reddish-brown color, and is  
"slightly magnetic."

Page 225 = five miles above the above  
locality on farm of Mr Harris.

"here it is highly magnetic fine grained  
"and dense - reported 3 or 4 feet  
"thick."

"In Granville Co. is an outcrop  
"of coarse granular somewhat  
"slaty magnetic ore."

"hand specimens of very coarsely  
"crystalline magnetite of ten to  
"fifteen pounds weight associated  
"with syenite are found within  
"a mile of Raleigh."

Sanie

Page 223. Chatham & Orange Cos.  
 "About 1 mile north of the Buck-  
 "horn mine is a small vein about  
 "1 foot thick of a highly magnetic  
 "ore". —

Page 224 Chatham & Orange -  
 "Besides the localities already  
 "mentioned, a number of additional  
 "at outcrops of ore have been  
 "noted mostly magnetic; one  
 "2 miles north of Buchanan (at Lewis)  
 "yielding 57.77 per cent of iron and  
 "there are 4 others in a southwest  
 "direction, for 10 miles to the head  
 "waters of Little River - at McKel's  
 "Dalrymple's and Buchanan's")

Page 232. Chatham Co.  
 "A fine quality of magnetic ore, dense  
 "metallic and very pure, is found on  
 "the east side of Hawk River and about

two miles distant at the foot of  
Tennell's Mountain on the farm of  
Mr. Snipes"

Page 234 Orange Co.

"A Magnetic ore makes its appear-  
ance about 20 miles northeast-  
ward, 3 miles beyond the upper  
forks of the New River in the  
Southeast corner of Orange County  
on Knapp of Rock Creek on the  
farm of Mr. Dr. Woods."

# Geological Survey of Missouri<sup>35</sup> Swallow 1855-

Page 153-

"At Shepherd Mountain the ore  
"is usually a mixture of specular  
"and magnetic oxides (the  
magnetic being the least abundant)

Page 72 - 2 part

"The magnetic iron ore gives a  
"black powder - for the manufacturing  
"of iron it is not inferior to any of  
"the other ore, and is found at  
"Shepherd Mount. intermixed with  
"specular iron"



Biological Survey of Missouri  
by Brothman - 1873-4

Page 176 Bates County

"On the slopes of Sand Mounds at  
the County line and also north of  
Rockville an exposure of Stenotoma  
of light specific gravity but it  
is often too siliceous."

Page 255- Adair County.

"On the Chariton River two miles  
north of the south county line  
Numerous masses of Leptæa  
are washed out of the bluffs and  
strata along the river banks, -  
studded with Leptæa. The  
"Leptæa" globules vary in size  
from a few points to that of ones  
sixteenth of an inch."

Pages 646 to 661. Describe the various  
distributions of Leptæa deposits, of Leptæa  
now on banks of the river most of the  
ones being coarse, shaly or sandy, but  
masses of Leptæa of Leptæa ones

Geological Survey of Missouri 39  
1853-73. Pumphelly

Since sketches of iron deposits in  
Counties. Are classed principally as  
brown Hematite - No Magnetite ore  
or sands mentioned.

Geological Survey of Missouri by  
Pumphelly in the West & Co. 1873  
Pages 196-214 - List of iron ore  
Locations, among etc.  
"Shepherd Mountain Iron Co. Benton Co. Mo."  
"Clinton Bank Iron Co. Maguire & Co. Mo."  
Are the only mentions of Magnetite ore

Exploration & Survey of western 12  
100 Meridian - Volume 1870 - Page  
Page 261-

An excellent quality of Magnetite is  
found near Iron City - in Carbonate  
Utah - very easy of access and ore

"Granites practically inexhaustible"

Page 370 - Lehigh River Mountains

In the vicinity of Lehigh River  
they contain Magnetite in prob-  
ably in quantity to give it  
economic value."

Explorations Lehigh River  
Mississippi River Valley  
1853 to 1856

Entirely Zoological

Natural History of New York

Mineralogy - Lewis C. Beck, 1842

Page 392. Localities of Magnetite  
Iron Pyrites -

Essex County 1 1/2 miles north of  
Port Henry on Property of C. Stone  
strongly attracted by the Magnetite.

"Lewis County, associated with  
magnetite iron ore at the O'Neil  
mine, the Rich Line mine, near  
Greenwood furnace, and in other  
parts of the town of Monroe."

In Connecticut, the specialized  
variety of magnetite iron pyrites  
occurs at Monroe and in Thimbleton.

Page 22: Magnetite Iron Sand  
whole coast of Long Island.  
— on the banks of the Hudson near  
West-Point and on the banks of  
many of the streams of the High-  
lands. — It occurs in great  
abundance at Port Henry and  
elsewhere on Lake Champlain —  
on the shores of Lake Ontario in  
Monroe Co and on those of  
Seneca Lake and Lake Erie

And on the banks of <sup>45</sup> ~~Mos~~  
 River at Gyondale in Lewis Co.

Minerology Dana, 1868

Page 151 Magnetite

"In North America it constitutes  
 "vast beds in the Azores, in the  
 Adirondack region Warren, Essex,  
 and Clinton Co's in Northern New  
 York while in St. Lawrence Co  
 the iron ore is mainly hematite  
 also similarly in Canada, in  
 Hull, Grenville, Madoc, etc. and  
 at Leominster in Pennsylvania  
 and at Magnet Cove Arkansas.  
 It also occurs in New York in  
 Saratogo, Herkimer, Orange and  
 Putnam Co's; at O'Neil's mine,  
 Orange Co., in Maryland

In Maine, Raymond, Davis<sup>57</sup>  
 Here, in an epidote rock; at  
 Marshall's Island, masses, strongly  
 magnesian. — In New Hampshire,  
 at Franconia, in epidote and  
 quartz; at Swanzey near Rum,  
 and Unity — In Vermont at  
 Marlboro; Rochester, Bethel and  
 Bridgewater, in crystals in schis-  
 tist state. — In Conn. at Lanes  
 (Haddam) in crystals — In  
 New Jersey at Hamburg near  
 Franklin Furnace — In Penns.  
 at Goshen, Chester Co.; at Webb-  
 Minn, Columbia Co.; in dendritic  
 delineations forming hexagonal  
 figures, in mica at Pennsbury  
 and New Providence — In  
 Maryland at Deer Creek — In  
 California in Sierra Co. abundant.

Grewia

Massive and in crystals; <sup>49</sup>  
 Plumas Co.; Mariposa Co.; east  
 of the Mariposa estate, on the  
 trail to the Yosemite; Placer Co.  
 Mts. ranch; Los Angeles Co.;  
 Canada de las Uvas; El Dorado  
 Co., near the Boston Copper Mine  
 in oct. And at the El Dorado  
 Occid. copper mine. — In  
 Canada at Sutton in crystals;  
 Bromet, etc. — In N. Scotia, Digby  
 Co., Nichols Mt. in fine crystals.

Page 59 *Magnesia fasciata*  
 In Vermont at Stafford, Corinth and  
 Shrewsbury. — in many parts of  
 Massachusetts — In Cornwall, in Sum-  
 mit with topaz, in Morros and else-  
 where; in New York 1 1/2 miles north  
 east of Port Henry, Essex Co.; near

"Natural Bridge in Diana Lewis  
 Co; at O'Wells mine and else-  
 where in Grange Co. - In New  
 Jersey Morris Co. at Hardarton,  
 cleavable masses. - In Penna.  
 at the Gap mine Lancaster Co.  
 Nicotiferous, - In Tennessee at  
 Ducktown mines abundant. -  
 In Canada in large veins at  
 St Jerome etc."

Page 870 Magnitite

"A Nicotiferous Magnitite  
 occurs (according to Petersen)  
 north of Pigeon Lake in the east-  
 ern Alps."



# Agriculture and Geology of <sup>53</sup> Maine 1862

## Page 421. Magnetite

Specimens of a superior deposit  
Union were placed in my hands  
for analysis. Remarkable small  
proportion of iron 64.

## Page 1122 Black Sands (Glen)

Where the Canada road crosses  
this belt in Sandy Bay the vein  
looks exceedingly promising and  
the banks of the streams are full of  
the black sands.

## Page 372 Magnetic Iron

"In the north western section of  
Linneus, iron ore is found  
combined with the slate. The ore  
was obtained that was strongly  
magnetic."

## The Iron Region

Fortin and Whiting 1867

Page 18. Michigan - Southward  
from Lake Lake -

"Chlorite slates and vast masses of  
specular and magnetic oxide of  
iron"

Page 22. "On the north side of Mackinac  
"quartzite in numerous slabs, mag-  
"netic iron is seen associated with  
"hornblende or quartz"

Also in various other places  
in the Lake Superior Region.

# Geology of Massachusetts  
1833 Hitchcock -

Page 230 - Iron sand

"Brushes of this substance may  
sometimes be collected on the  
Montague shore of Connecticut River

40 rods below Turner Falls <sup>57</sup>

Geology of Vermont (Adams) 1846

Page 23- "Iron sand in the soil of Laron slate regions"

Page 257 "Magnetic Iron ore in the form of iron sand in considerable quantities occur in the sand beach just north of Clay point." Waterford Co (?)

Geology of Wisconsin 1873 <sup>57</sup>  
Vol. 2.

Page 239.

Magnetic iron sands popularly known as black sands in the entire series of the Lake - (Probably Lake Michigan)

Geology of Massachusetts 5841  
No Mention of Sands

American Cyclopaedia  
 Page 407. Vol. IX

"Like Superior the beds were  
 once all magnetite in compo-  
 sition and have been changed  
 to sesquioxide by the addition  
 of oxygen."

"All the Missourian specular iron  
 is now or was magnetite."

Same page 409. Magnetite  
 "Fast beds in the gorge of the  
 Adirondack region, Warren,  
 Essex, and Clinton Cos. in Northern  
 New York —"

In Morris, Sussex, Warren,<sup>61</sup>  
 and Passaic Cos N. J. —  
 Cornwall in Lebanon Co. Penn.  
 at Shuyl, Greenville, Madoc, &c.  
 in Canada — Greensboro  
 North Carolina. — Large de-  
 posits in Sierra Co. Cal. —  
 and in Oregon.

**Menlo Park Notebook #212 N-81-05-23]**

This notebook covers the period May 1881. Most of the entries are by Charles Batchelor. There are also a few entries by Edison and John Ott. The book consists of notes and drawings of items to be sent to the Electrical Exhibition in Paris. Several loose pages, attached to page 133, contain notes relating to a contract between the Edison Lamp Company and the Edison Electric Light Company of Europe, Ltd. The label on the front cover is marked "Orders for E. E. at Paris in 1881." The book contains 280 numbered pages.

Blank pages not filmed: 188-215, 230-231, 238-275.

Missing page numbers: 25-26.

x E 172 N-81-05-23

Exhibition May-23 1881 1

People who go -

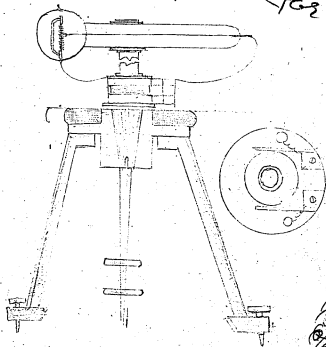
- 1 Kinney
  - 2 Kinney's Boy
  - 3 Dr Moses
  - 4 Suebel
  - 5 Atchison
  - 6 Quinn
  - 7 Hammer
  - 8 Hipple
- Four

Instrument & exhibit = 3

Thermo Galvanometer with mirror  
in Vacuo

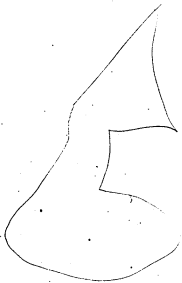
2

May 23 1881.  
TGG





Air engine with platinum  
spiral in cylinders



3 Bambo<sup>7</sup> Samples and all  
other fibre samples

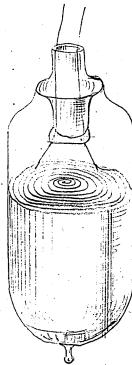
2 Copper Calorimeters for  
testing lamps.

Never ending Clockwork -  
Davis is making clock  
see him

May 23 1881

Tag

Mica condenser in vacuo



May 23 1881

TAG

Made working  
drawing J. F. Pitt

7 Chalk Battery

May 23 1881  
Taz

8 Agar lighter to be worked  
on the system

May 23 1887

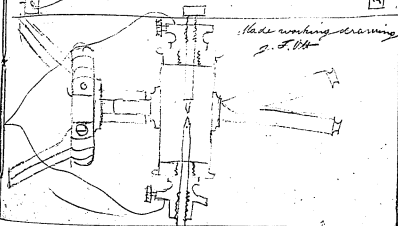
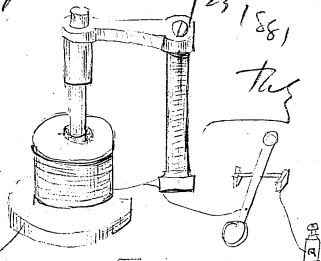
Tas

9 Electric pen (3) tier  
~~10~~ Also one 'Gramme' pens  
 2 Reed pens  
 2 Presses  
 1 Automatic Presses from  
 S. Morse.

May 23 1881

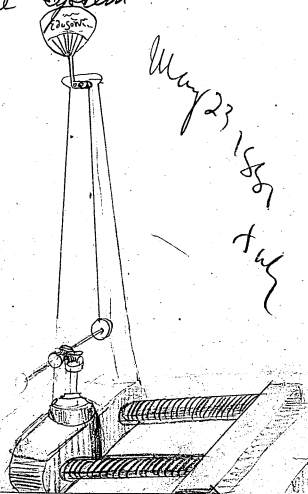


10 *Etherscope and other*<sup>21</sup>  
*apparatus* May 23, 1881



Made working drawing  
 J. F. V. H.

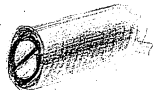
11 Electric fan to work on  
the system



13 *Motographie Galvanische*

14 Inertia Telephone

15 Samples of all street  
connection boxes all  
house boxes and street  
mains from Kuesi -



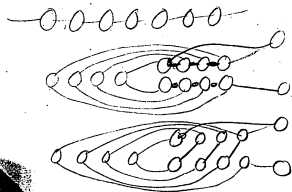
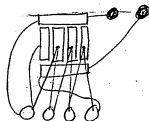
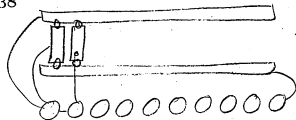
May 23, 1881  
Tues

16 12 Platinum spiral  
lamps  $\frac{L}{1,000}$  20/  
high sacs

17 6 ft spiral ramps  
Thermal regulator

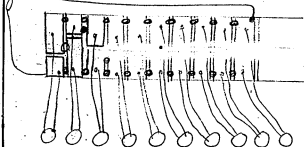
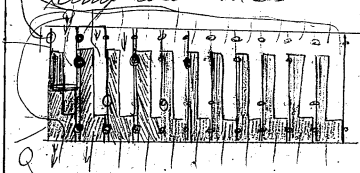
6 Turn down lamps





Resistances —

~~and~~ ~~with~~ with  
lamp resistances



May 28 1881  
Chas. Patchen  
TAL

2 Sets of Leyden jars  
in high vacuo but  
set lamp size

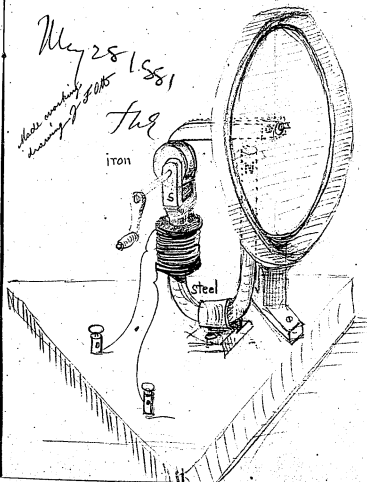
## 1 Magnetic Photograph

May 28 1881  
 Made working  
 drawing of photo

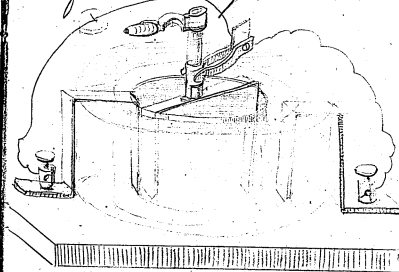
the

iron

Steel



1 Current Regulator  
fluid 'Budge'



Made working  
drawing J. F. O. O.

May 28 1887

Tur

1 Hand ship Photograph  
for illust: principles

Sample every kind of  
telephone - at least  
30 kinds from his closet

1 Photometer for use there

in good style

1 Electric piano

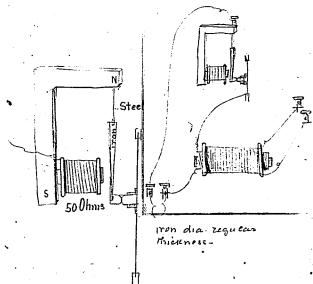
May 28 1981

Tag



1 Electric pump by  
Sewing Machine Motor

# 1 Telephone repeater

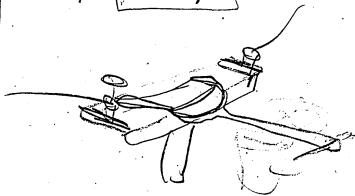


MAY 28 1881

Made working  
drawing J. F. Otto

TAR

1 Relay worked by  
cutting in & out of Carbon  
Strip



made working  
drawing J. F. O. H.

May 28 1881

Tar

Signalling by Thallium  
line in Spectroscope

May 28 1881  
Tag

*Asimeter*

stethoscope -

Small induction coil  
in Vaeno terminals inside

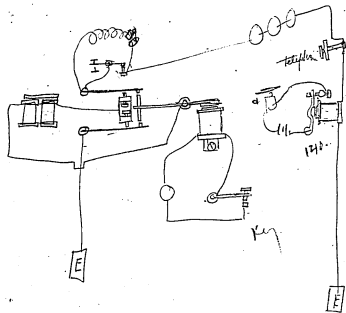
May 28 1881  
Tag

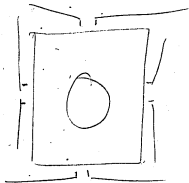
Vibrating puncher



Pneumatic pen

Duplex of patent  
217.782 =





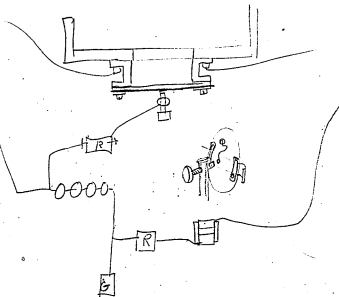
659

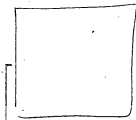
Working model of Pat. 75

203 014

Can make at Ment-  
Page 662

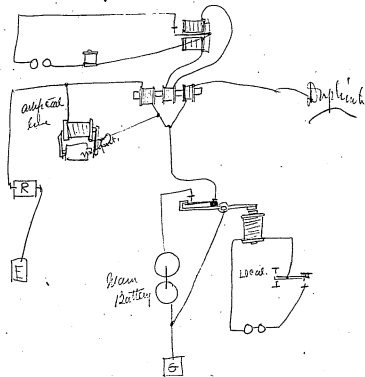
Ed. Pat-





Suplex of patent

178 221



2 Gold and Stock <sup>79</sup>Mailes  
hand transmitta -  
Key and shelves etc-

Roman letter perforator  
Trans and Rec with extra  
pens.

41 Morse Automatic-

1 Paper wetter

~~Clock~~

1 in Case of 100 lb yellow paper

250 lb. Receiving paper

500 lb Perforating paper

1 Morse perforator

2 Automatic insts, table &amp; Chair

~~Self~~ Self paper winder

Clockworks for copying

Extra pens

3 Gel. pens

24 Automatic Stunts

2 Universal printers



2 American telephones  
Combinations

2 English Telephone  
Photograph

1 Pressure Relay with  
Sounder and Key.

1 Photograph Relay  
with Key

2 3 Key perforators

1 Carbon Rheostat

/ Musical Sel. outgo

Q Fac-simile's



/ Phonomotor -

1 American District  
1 Domestic Instruments  
with recorder —

1 Phonograph arranges  
to be talked to by  
Motograph

109  
Photographs of 65 3<sup>rd</sup> Ave

Goetts' Street Shop

Lamp Factory

at Menus

Laboratory at Menus

Also Peter W's

"Graphic" picture of  
electric Railroad with  
date on it

~~My~~ Patents

6 Sets of my U.S. patents  
bound

2 Bound Copies of all Eng  
patents to date -

2 Bound Copies of all Eng  
patents relating to Elec.  
Light

25 Copies Photo Lith. of "Light"  
French Patents on "Light"  
to date

So

Scrapbook of publications  
relating to Elec Light  
especially Herald Dec  
21 1879 and all about  
then and few months later  
Philo. Ledger - Steamship Col.

<sup>115</sup>  
4 Cells Calland battery  
copper above blue vitriol

116

58

117

*Drawings of Electric Buoy*



Working models of all 119

different transmitters

Shown in Page 111 Vol 5

Expen Researcher

P 171 Vol 5

P 175 - Vol 4

Sewing Machine Motor 121  
& machine

122

61

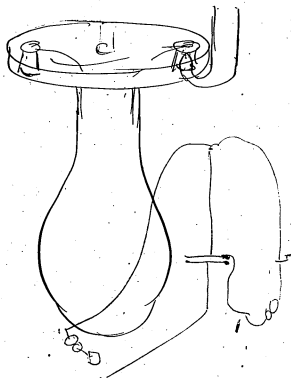
123

5 HP Motor

1 Dynamo  $\frac{9}{1000}$  for com-  
petition test

1 Case of Graphite sheets  
and loops from them

128



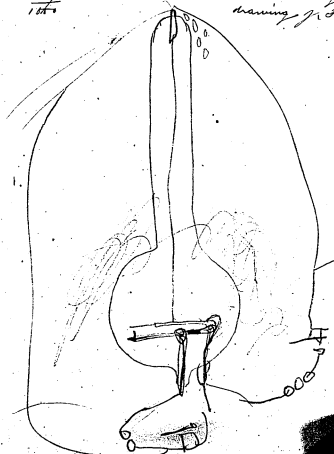
64

129

# 1 Expansion Relay

104

Made working  
drawing, J. F. O'H.



1 Kerosene lamp with a  
little blowed ('Electric')

Lamps

Get Upton's order for Pairs  
given him by Edison



Edison Lamp Co -

You will proceed  
to make for the

Edison Electric Light  
Co of Europe Limited  
5000 A Lamps,  
not less than 100  
ohms and with  
an economy of 10 per cent  
horse power - and  
not to vary more than  
2 Volts = ~~these lamps~~  
also 2000, 8 candle  
A Lamps, - and 2000  
8 candle B Lamps,  
+ 500, 16 candle B lamps

The 8 candle <sup>2</sup> A Lamps,  
to work on the same  
voltage & current as the  
A 16 candle Lamps -  
& not to vary ~~any more~~  
more than 2 volts to  
have an economy of  
20 per <sup>electrical</sup> hp.

The B Lamps to be  
worked on the same  
current as well,

~~You will also~~

~~And~~  
also a few of the  
B Lamps should be  
put in very small  
globes =

about 25-<sup>3</sup>4 candle  
lamps should be  
made that they can  
be worked with a  
battery =

You will also furnish  
4 lamps with a  
Crown of Carbons  
A size with 4  
inside parts sealed  
in one large globe  
all carbons in multiple  
arc - and any other  
nice thing you think may  
be ~~valuable~~ <sup>of price</sup>  
charge ~~that~~ <sup>to the Ed. Co</sup> ~~of a product~~

16. 10 / 18  
7 3 9 - 27  
2 1 7 5 - 15 ✓  
1881

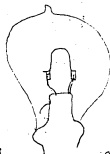
E. H. G.

Copy Cont<sup>less</sup>  
for England  
Paris

3 A Lamps Co want order

≡ ≡

Continued



worked by Battery  
very small surface

B. L. Co - making - Fibres cut  
have to put them  
in straight.

SEE  
TAC

1/4  
1/4

Tai

May 28 1881

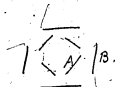
Tai

Tai

Samples of Carbonizing  
Paper - Wood etc

New nonmagnetic Dynamo

Crown Camps



CL. Co want order

142

70

*Lamp*

143

7 2 Lamps

8 B Lamps all in one flote  
in multiple arc

E. L. Co want order



6 Lamps

Graphite Carbons  
C L Co got them  
want order

1 Vote Recorder

1 E.M.F. regulator  
for main system

*Beam Meter -*

12 Regular Melts

1. Junior Kebr Meter

1 Quadruplex-get.

Chandeliers  
 Spring brackets.  
 Brackets  
 Globes  
 Shades.  
 Safety catches.  
 Cleats.  
 Wire appliances.  
 wire  
 Tools.  
~~Out~~ Switches.  
 Groh lamps.  
 Flexible cord.  
~~Mining lamps.~~  
 Detachable Chandeliers



1 Magnetic Ore  
Separator—

1 Steam Dynamo  
and appliances

Lamp stands & also  
auto lamps

168

83

High Vacuo tubes

169

1 Lamp with Mercury  
Column  
 $\frac{1}{8}$  Buss 6" long Bamboo

172

85

173

6 Ground stopper lamps  
B.L. Co = Making now

174

86

6 Iron wire lamps

175

176

87

6 Nickel wire Cans

177

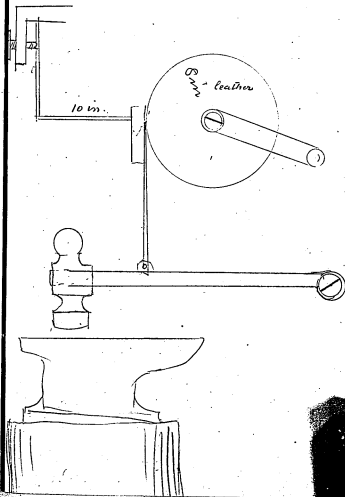


Certified Copies of the  
patents on telephone  
to show the Judges as to  
date when talking over  
the Carbon button and microphone

Johnson's Clockwork  
Motograph

Switch board as  
per Johnson's order-

*Motographic trip hammer*





the Cap  
plate this  
on

prox punch may 28

T ok 188

In telephone department  
I want:—

~~1 Inertia telephone~~

{ Every kind of telephone from  
Caveat

Telephone Repeater

2 American telephone combinations

2 English telephone photographs

1 Musical telephone outfit

1 Phonographic telephone

{ Transmitter from Vol 5 Exp Cos.  
Pages 111 171

{ Vol 4 175 p.

Johnson Clockwork photographs

South bound

Lamps we want

6 Special Pt Lamp 17

~~17 18~~

6 turn down lamps 18

66

Reigman is making  
May 25<sup>th</sup>

200 3 Light Chan. of which  
5 detachable  
a few with globes

100 2 "detachable"

50 + " "

50 Swung arms  
25 double joint  
25 single

100 Rigid brackets with cocks  
on cockrets

6 Desk lights

4 5 light Chandeliers with  
1 drop light & center

1000 Shades

250 Ornamental Safety Catch

500 plain wood 4 with  
1000 ~~drawn~~ out off Plugs

Chairs



Wire

Double pointed tacks

Lead wire

100 ~~Sockets~~ Extra SocketsScrews for Cleats etc.  
flexible Cords

|             |   |             |
|-------------|---|-------------|
| Wash. Tools | { | Pliers      |
|             |   | Solder iron |
|             |   | hammers     |

|          |    |      |
|----------|----|------|
| Switches | 25 | No 1 |
|          | 12 | No 2 |
|          | 5  | No 3 |

~~Sewing mach motor and~~  
~~S. M.~~~~Bergman finished by 1st June~~  
~~finished 8th June~~~~Emt Reg - Main system~~  
~~Berg. made~~  
~~Geork St~~~~Mirror tube~~  
~~Decor~~  
~~Berg. 1st June will be ready~~~~Asimeter~~  
~~no appliances~~  
~~Berg done~~

~~Beam Meter~~  
~~Send to Bergman~~

~~Carbon Rheostat~~  
~~done Bergman~~

~~Stock Quotations etc~~  
~~Berg ~~copy~~ June 2~~  
 will

~~Private Line Universal~~  
~~Berg 1st June~~

~~Kinnery Just~~  
~~Bergman ~~at last~~ See Kinnery~~

~~Domestic Just~~  
~~Berg find two~~  
~~I shall have to get Reorder~~  
~~to Bergman for it~~

~~Relay - out out further stuff~~

3 Duplexes got order for  
 Bergman

~~Pressure Relay with  
Relay + 1Cv  
Bergman - finished~~

~~Mastograph ditto  
ditto~~

~~Automatic <sup>1 P. 10</sup> <sup>2 P. 10</sup> <sup>3 P. 10</sup> <sup>4 P. 10</sup> <sup>5 P. 10</sup> <sup>6 P. 10</sup> <sup>7 P. 10</sup> <sup>8 P. 10</sup> <sup>9 P. 10</sup> <sup>10 P. 10</sup> Complete Berg  
Bergman ~~10th~~ June 5th~~

~~Perforator finished~~

~~Roman letter Automatic  
Perforator done  
used 10th June~~

~~3 Key Perf  
Berg~~

~~Lel. Don Amsh.  
B. done~~

~~Bug <sup>tel</sup>  
B. done~~

~~Inertia telephone  
Berg - <sup>sent one to B</sup>~~

~~Musical <sup>outfit</sup>  
Berg - 8th June~~

228

Thoms ~~tel. outfit~~  
 Bag. ~~1st July -~~

---

~~Clockwork Mols~~  
 B. ~~1st June -~~

---

~~Switchboard~~  
 B. ~~1st June~~

---

~~Cigar lights~~  
 Get drawing for Bag

---

~~Kerosene Lamp~~  
 B. got deliv. May 26

---

Vote Recorder <sup>229</sup>  
 Bag. ~~Edison gave sketch~~

---

~~Hand strip Mols~~  
 B. ~~finished~~

---

Laboratory is making

~~Platinum spiral~~ h

Turn up and down lamps

Chalk battery

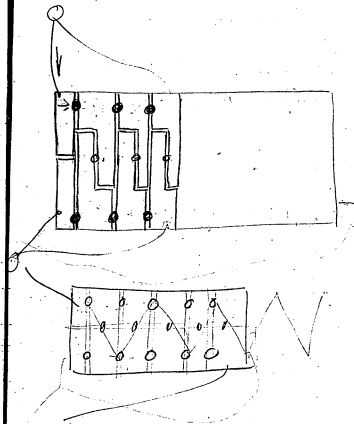
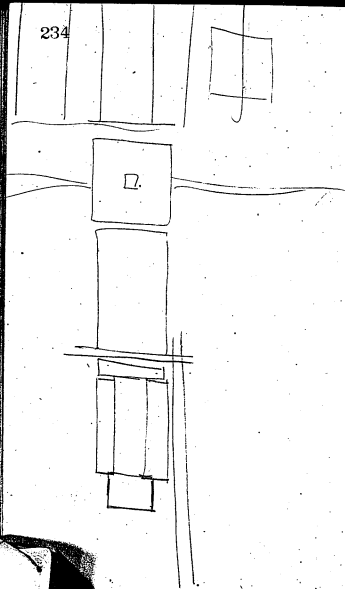
Platinum spiral regulator  
lamps -

Ethere apparatus

Thermoscope

10

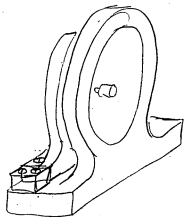




236

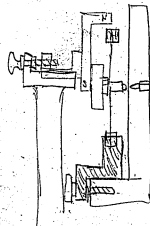
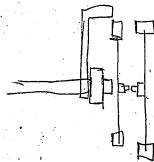


237



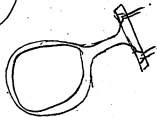
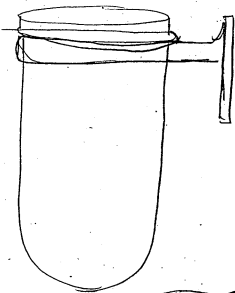


278



279

280

Bergman for Pump Motor  
Fan Motor

**Menlo Park Notebook #213 [N-81-05-14]**

This notebook covers the period May 1881. The entries are by Charles P. Mott. The book contains the results of a search for literature about magnetic lines of force and their relationship to the setting of commutator brushes. The label on the front cover is marked "Lines of Magnetization," "Dynamoes," and "C.P. Mott May 14, 81." The book contains 280 numbered pages.

Blank pages not filmed: 120-271, 274-279.

Missing page numbers: 5-6.

LIBRARY OF THE  
BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

*From L. Mary*  
GENERAL ELECTRIC.

44 Broad St. N.Y.

*May 1, 1896*

From Mr. Edison May 14 1881 1

"All Articles with page and date  
describing any Magneto machine  
duplicates"



"Find out the exact words all  
writers use in describing how to  
set the commutator brushes =

"Line of Magnetization"

"Commutators set at right-angle  
to the line of Magnetization"

Higgs 1879

Pages 77 to 126 inclusive describes  
 machines of Piesse, Clarke, Breguet,  
 Brush, Wallace Fanner, Seimens,  
 "Alliance" Holmes, Wilde, Ladd,  
 Trouve, Rapiuff, Gramme, Edison,  
 De Merville, & Lontin.

Page 80 Brush

"When the section of wire is passing  
 "the neutral point on the armature  
 "the plates are in contact with  
 "the insulating material of the  
 "cylinders between the corresponding  
 "segments, thus cutting the sections  
 "which is at the time useless, out  
 "of the circuit altogether,"

Page 82 (Seimens & Gramme)

"The plates press upon the cylinder  
 "in this case at points corresponding

Stiggs

"to the neutral point of the armature  
 "thus being at right angles with  
 "their position in the first arrange-  
 "ment."

---

Page 99.

"Mr Kramme collects the currents  
 "developed in the ring of his machine  
 "by establishing collectors on the  
 "line - where the currents in contrary  
 "direction encounter each other." —  
 "The friction brushes on the pieces -  
 "are in a plane perpendicular to  
 "the polar line, that is at the middle  
 "or neutral point."

---

Page 121. Lortin Machine

"A metal strip is placed opposite  
 "the pole of the electro magnet to  
 "collect by contact the electricity  
 "generated in the coil at the instant  
 "that its polarity becomes reversed."

The current from the small machine  
 "is led to the rotating Magnets through  
 "the flat brushes of silvered copper  
 "wire attached to the frame work of  
 "the machine, and in rubbing contact  
 "with two insulated copper cylinders,  
 "one connected to each end of the  
 "magnet circuit."

Describes machines of Weston, Holmes  
 "Alliance" Wilde, Siemens, Ladd  
 Dickey, Gramme.

Page 337 Siemens,

"The currents so generated are collected  
 "on two metal rollers, or brushes, so  
 "that at two points, diametrically  
 "opposite the single sector pass  
 "under the rollers or brushes with  
 "elastic pressure giving up to them  
 "their electrical charge".

Page 339 Gramme

"The tails of the radius bars are all  
 "grouped together round the central  
 "axis and they are rubbed against  
 "by suitable collectors, which take  
 "up the electricity".



Schoolhouse. 1879

Pages 13 to 27 inclusive describe, *Mechanics*  
 "Holmes-Allison, Le Meritens, Siemens  
 Gramme, Wilde, Wallace-Farmer,  
 Brush, London

Page 14. Holmes Allison

"The positive one, current being collected  
 "on the axis of the machine; while a  
 "concentric, but insulated cylinder  
 "is used for the negative one".

Page 15. Le Meritens.

"No commutator or collector is required  
 "with the machine."

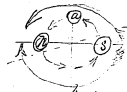
Page 19. Siemens

"Two brushes, tangent to a circular  
 "commutator, placed on the induction  
 "coil shaft carry off the electricity  
 "in one continuous direction."

Sprague - 1875

Pages 328 to 340 describe machines  
of Gramme, Ladd, Marens, Siemens  
Wilde.

Page 329



"a, helix resting on neutral line a, b, of the  
magnetic poles N. S. - line of motion from  
a to n -

"By means of a commutator on the line

"N. S. - a current can be obtained in  
"one direction, though not continuous"; -

"The point of change is not practically  
"on the line N. S. but in a line in  
"advance of it as shown by the dotted  
"line" — The position dependent upon  
"the quality of iron of the armature and  
upon the rate of rotation" -

Page 330 - Siemens

"Springs - fitted with a turned pad  
"of steel or other metal, press upon  
"the cylinder and take up the current."

Page 334. "Gramme."

"In the machine itself these springs are  
"replaced by brushes of wire thick enough  
"to press on, at least two contact pieces."

Page 337-



Gramme

"We may also regard the space between  
"the dotted lines of fig. 84. as a single  
"magnetic field."

Engineering Jan'y 21, 1881

Page 55 Brush Machine

"The outer ends of all the coils are  
 "brought through the shaft of the  
 "machine and are connected to commu-  
 "nating portions of the commutator,  
 "where the currents are collected by  
 "suitably placed copper plates or brushes."

Page 1 Jan'y 2, 1880. Dynamo Electric

Machines (generally) Editorial in recent

publications of Antoine Begault.

"He is thus enabled to explain a point  
 "hitherto supposed irreconcilable with  
 "theory, namely, the practice of sliding  
 "engines in setting the brushes or carbon  
 "bars of the current in the dynamo  
 "electric machines in an oblique  
 "position against the commutator,  
 "and unsymmetrical with respect to  
 "the field magnets of the instrument."  
 "He not only explains this but points

Engineering Jan 2.80

"and that it is an absolute necessity  
 "of the case, and that upon this position  
 "will depend whether the machine is  
 "better suited to be a generator or an  
 "electric motor." —

"Faraday first recognized the significance  
 "of the so called lines of magnetic force  
 "which are now crossing in curves through  
 "every magnetic field when iron filings  
 "are sprinkled over it" —

"Faraday laid down the following  
 "properties as then possessed by these  
 "lines of force: Firstly, the lines of force  
 "tend to shorten themselves. Secondly, lines  
 "of force lying in the same direction side  
 "by side repel one another. To these  
 "Mr. Breguet adds that, a line of force  
 "when it passes through iron or other  
 "metal capable of magnetic susceptibility,  
 "must be regarded as if shorter than  
 "one of equal actual length passing  
 "through air."

Engineering, Jan'y 2. 80

Page 13. Commercial description of Brush.  
Jan'y 9. 80Page 37. "Herald's" description of Edison's -

Feb'y 6. 80 Bugnet

Page 116. description of Siemens - also touches  
Edison as outwardly a business Aristocrat.

The sectional mercury cups are judiciously placed so that their edge of just contact lies along - which we may call "the diameter of commutation," at right angles to the line joining the magnet "poles." (Mercury cups act as brushes)

Feb'y 13. 80 Bugnet

Page 136. Grammes.

An arm carrying a wire brush runs to "place in communication the coils of the moving electro-magnets, with the exciting circuit." The current is collected and "transmitted by small brushes of silver & copper wire." The brushes are moved by "means of a small endless screw."

Engineering July 20, 80 25  
Page 154. Brugnot

"The magnetic force is concentrated  
"into that part of the field immediately  
"opposite the poles." (diagram shows  
the most numerous lines between the blocks  
marked N. & S.)

Page 155 Brugnot

"To obtain the best possible result it is  
"necessary to adjust the brushes which  
"take the current from the commutator  
"to an oblique position, different from  
"that dictated by theory."

Page 228. Mch 19, 1880 - Siemens  
Historical description of Dynamo of Siemens

Page 424 May 28, 80 Thomson

Electromotive force experiments, resistance etc.

Page 63 July 25, 1879 (Kerridge)

In description of Gramme  
"The lines of magnetic force within the ring  
"are maintained parallel in direction  
"to the revolutions of the wire and therefore  
"with the annular axis of the ring."

Page 63 July 25, 1879 Gramme

"The opposite ends of these conductors  
 "are metallically connected to as many  
 "insulated copper strips arranged side  
 "by side around a circle, so as to form  
 "sectors of what is called the commutator  
 "cylinder upon which the metallic collecting  
 "brushes are pressed by means of springs  
 "and screws. These brushes are composed  
 "of hard copper wire electrically plated with  
 "silver, and their object, by forming a  
 "sliding contact between the internal and  
 "the external circuit of the ring is to offer  
 "a passage for the current induced in  
 "the coils of the armature so as to enable  
 "them to be used for doing external work."

— Such a ring is rotated in its own  
 "plane in a magnetic field produced  
 "by two opposite magnetic poles diamet-  
 "rically opposed to one another," —

"By placing collecting conductors in  
 "suitable positions, the two opposing branches  
 "of the current unite and flow out together  
 "forming an external current of their combined  
 "strength."



Page 63 July 25, 1879 (Kramm's Mch.)

"Two magnets having their dissimilar  
"poles opposed to one another, and  
"producing a magnetic field between  
"them, within which is rotated a  
"ring" etc —

"The effect however of rotating the ring  
"is to cause each point in succession  
"around the ring to be brought under the  
"inductive influence of the magnets, which  
"has precisely the same effect as if waves  
"of magnetic force were constantly traveling  
"along round the ring in the reverse  
"direction to that in which the ring  
"is turning." — "Important action is  
"taking place between the lines of force  
"within the magnetic field and the con-  
"volutions of the coils of the induction  
"ring." — "As the lines of force connect  
"between the magnetic fields of the two  
"magnets form a series of elliptical arcs  
"joining their two poles."

Engineering July 26-79

31

Page 70 (Serrin's) Upston on efficiency  
 test of Serrin's machine made by  
John Hopkinson

Page 372 Nov. 12. 1879.

Describes Serrin's Magneto-electric Machine

Page 173 Aug 29. 79

Describes Lister's Machine

"Against the surface of this commutator  
 "collectors are pressed by means of springs,  
 "the one taking off the positive current  
 "and the other the negative."

Page 101 Aug 9. 1870

Describes Serrin's Machine

"Part of a closed electrical circuit is caused  
 "to move within a magnetic field so as to  
 "cut through the lines of magnetic force,  
 "in a path more or less perpendicular  
 "to their direction."

Page 102 Aug 18. 1879

"The currents are collected by conducting  
"brushes pressing against the commutator  
"as it revolves." — "The collecting brushes  
"are so placed with regard to it (commutator)  
"that they take off the current generated by  
"the machine at the position of maximum  
"effect — that position gives the least  
"spark at the commutator" and in-  
"dicates the machine is working at its  
"greatest efficiency." —

"Due in to every machine of this construc-  
"tion one position for the brushes to  
"bear upon the commutator in which  
"the current is strongest, and where  
"sparking is reduced to a minimum."

Saw 24.79 Page 75. — General-  
Historical. discussion Machines  
generally. —

Page 309 April 11, 1879

Describes Wallace Farmer's robust system,

"The commutators - on each pole, above  
"and below, by a pair of metallic brushes  
"to lead away the currents that have  
"been generated in the armatures,"

Page 403 May 9, 79

Efficiency test of Siemens' machine  
made by E. Johnson -

Page 513 June 20, 1879

General article and description of  
mechanical generators -

Page 63 July 26, 1878 - (Ed. Lockley's system)

Describes the Gramme Machine.

"The current is led to the rotating magnets  
"through flat brushes composed of silber  
"copper wire, fixed to the frame work of  
"the machine, and rubbing against the  
"insulated drums or cylinders of copper,  
"the first being connected to one end of the magnet  
"circuit and the second to the other."

Page 391 Nov-15-1878

- Electro dynamic illustration -

"If an opposite pole be substituted for  
"that of similar polarity, attraction will  
"take place which will be illustrated by  
"the running together of the lines of force  
"radiating from both magnets, so as to  
"form between them a bundle of little  
"loops connecting the one pole with the  
"other."

Page 362 Nov. 1, 1878

"The produced currents of considerable in-  
"tensity all of which were collected in the  
"circumference of a circular disc <sup>laminated</sup> ~~laminated~~  
"a commutator, the opposite current direc-  
"tation for one half of its circumference  
"being opposite in magnetic direction  
"to those upon the other half," a separate  
"contact brush serving to carry off  
"the current from each half."

Page 364 *Nov. 1, 1878* -  
*Schroeder* - Siemens Machine,  
 "Two brushes tangent to a circular commutator  
 take place on the induction coil shaft  
 "carry off the electricity in one continuous  
 "direction".

Page 526 *May 28, 78*  
 "Give the description of Siemens Machine, by  
 Fontaine,  
 Page 63 *May 25, 78*  
 "Dimensions & Power of Siemens Machine"  
 Kings

Page 88. *Feb. 1, 78*  
 "Historical description of dynamos"

Page 119. *Jan. 18, 1878*  
 "Mechanical description of Edison's Machine  
 "A metal strip or rubber is placed opposite  
 "the pole of the electric magnet to collect  
 "by contact the electricity generated  
 "in the bobbin at the instant that  
 "its polarity becomes reversed." "a-  
 "similar rubber being applied to the other pole etc."

Page 333 Oct 26. 77.

Douglases Report to Trinity Board,  
on experiments conducted with various  
systems of electric lighting.

Page 303 Oct 19. 77

Trinity's report on same experiments  
each contain, comparative tests of  
machines of Holmes, Alliance, Edison  
and Siemens.

Page 184 Sept 1. 1876 - Describes briefly  
Breguet's machine—

"Twelve strips of copper are disposed radially  
"and to them are attached the two adjacent  
"ends of every pair of bobbins. The metallic  
"springs are virtually common collectors;  
"and as they are always in contact with  
"some of the radial strips they must  
"always be traversed by electric current."

Page 418. May 19. 76. "Alliance"

"At each revolution of the machine each  
"core has its magnetization reversed  
"sixteen times, being magnetized 8  
"times in one direction and eight  
"times in the opposite."

Page 393 Nov. 19. 1875. "Isis" Machine

"A rubber spring comes in contact with  
"the quadrants of the medallion and is  
"connected with the electro-magnet of  
"the machine and with the armature.  
"Care is taken that contact shall be  
"effected at the moment when the best  
"magnetizing current is developed. A  
"second rubber spring is connected with  
"the wire of the armature during the  
"other three fourths of the revolution and a  
"third again communicates with any  
"apparatus through which it may  
"be desired to pass the current."



## Engineering

Page 413 Nov. 27, 1871

Description of Gramme Machine

"It shows several segments of covered wire  
"with the free ends projecting from the  
"ring. These are attached to copper  
"strips which in turn are in electrical  
"communication with copper sectors  
"fixed on the spindle of the machine"

Page 425 Nov. 21, 73. Mechanical

Description of "Alliance" Gramme  
Serrins and Halske machines

"It is the <sup>segment</sup> part of the rotor on which  
"the useful current is collected by means  
"of the silver copper brushes

Page 294 Feb. 27, 1873 Gramme Machine

"The brushes which collect the current are  
"composed of a great number of copper  
"wires which are held together in a plate  
"in the form of a horn,"

Page 192 March 14. 73 Gramme Mach

"They are composed essentially, of  
"bundles of silver wire grouped  
"together and held in position by  
"plates and adjusting screws."

Page 291, April 25. 73 Gramme Mach.  
<sup>4 to 1000</sup> Historical description of Gramme Machine

"Two metallic brushes are in contact  
"with the disk; they collect the current  
"as it is generated and transmit it  
"to two large rings."

"Connect them with the same number  
"of copper conductors, placed longitudi-  
"nally on the disk. These conductors are  
"insulated from one another, and it  
"is from them that the brushes collect  
"the current."

"These currents are led to the axis of the  
"apparatus where they may be collected."

"by suitable metallic pieces at the  
"neutral points."

Page 289 April 26, 1872 *Engineering*

"Each rubber rests along on several parts  
"of the junction between the parts elements, the  
"resistance of which, when closed by the rubber,  
"is suppressed by the resistance of the air."

Page 67 Vol 12. *Scientific American*  
machine - no copy at Cooper's Libr. -

Engineering reached back to 1871.  
including Second half of 71 - from *Library*  
to *Library* Not in *Library*. And were  
back of 1871 -

Page 117

"In a uniform field the lines of force are  
 "straight, parallel, and equidistant,  
 "and the equipotential surfaces are  
 "planes perpendicular to the lines of force  
 "and equidistant from each other."

Page 147

"Every part of the conductor moving in  
 "a field and conveying a current  
 "(induced or not) is acted upon by a  
 "force perpendicular to the plane passing  
 "through its own direction and the  
 "lines of magnetic force in the field."

Page 153

"If some certain constant resistance be  
 "connected with the coil, by sliding some  
 "tacks near the axis, the current will be  
 "larger with many than with few turns."

Page 282 Induction - Black's Machine 53

"Two ends of the wire are directly joined, but  
"the two other ends are connected through a  
"set of springs rubbing on suitable contact  
"pieces on the axis, which two joined terminals  
"and the circuit is not complete till these  
"are joined."

Page 284.

"It is easy to arrange a set of contact  
"pieces on the axis so that although the  
"current must necessarily be reversed in  
"the coils they flow always in one direction."

Page 285 - Holmes Machine -

"Alternat coils have their iron cores  
"magnetised in opposite directions."

Page 286

"If the change in magnetisation could  
"take place instantaneously there would  
"be no limit to the electromotive force  
"then machines could produce." —

- "The change of magnetisation and of  
 "direction of the current occupies a very  
 "small time; and if the speed be in-  
 "creased beyond that at which the greatest  
 "change of magnetisation occurs, the  
 "electromotive force will fall off instead of  
 "increasing."

Page 259. Siemens Machine.

"The wires of the coils move almost di-  
 "rectly across the lines of magnetic  
 "force and the armature will be so  
 "magnetised as to help the induction  
 "so produced."

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Notes, article on page 56. of 73

Philosophical Magazine June 1873

Phil. Trans. civil (1867)

Phil Mag. S. 4. Vol. 34. page 81

Proceedings of the Royal Society, V. 18. page 369

Proc. of Phil. Socy of Manchester

Vol. 6 page 103

Same - Dec 15, 68 Phil Mag S. 4. Vol. 37. 54

Comptes Rendus de l'Acad. des Sci.

July 71 - Dec. 72 - (Mamm. Machine)

Page 252 April 9. 1869. - Wilde, mch.

"A pair of rings and a commutator  
"were fitted upon one of the annular-  
"spindles, which was made sufficiently  
"long for the purpose, and metallic  
"connection was established between  
"the rings of each machine and the  
"commutator in the prolongation of  
"the annular axis."

Page 56 July 25. 1872 - by Wilde.

"The segments are made to overlap each other  
"for a short distance so that the metallic  
"ribbons or brushes for taking off the  
"current bear on adjoining segments  
"simultaneously at the point of no  
"current and in so doing form  
"two closed metallic circuits for a  
"brief interval."

Page 52. July 17, 1874 Siemens described

Page 228. Aug 2.75: Wilde recites  
 "Nuevo Cimento" of 1864 Vol xix, p 378"  
 "by which to show that Gramme was  
 anticipated by Dr. Antonio Pacinotti."

Page 312 May 4, 1877.

"If we make the curve of Magnetization  
 of soft iron according to the values  
 "stained, or fused," etc

"After reaching the turning point the  
 "curve of magnetization goes at first  
 "with a strong, then with a very slight  
 "decrease to a maximum value."

"From the remnant magnetic moment of a  
 "bar, a function of the previously acting  
 "magnetic force, a curve of magnetization  
 "was constructed."



Page 302 Oct 26, 1877. Report of Prof. Dugless on  
Efficiency, size, and cost of Siemens  
Siemens's Gramme's Machines

Page 383. Nov 30, 1877

General description of principles of Machines  
 quoted principally from M Fontaine and  
 "Eclairage à l'Electricité, Remarque-  
 ments Pratiques." Continued page 401

Page 401 Dec 7 77. Desautels, Maudslays  
 Alliance, Siemens, Gads, Van-  
 Malderon & Co.

"The currents are all collected in two  
 "conductors one of which abuts on the  
 "axis and is thence put in communi-  
 "cation with the rest of the apparatus."

Page 435 Dec 21 77 (continued above)  
 Describing the Gramme Refuse for a more  
 full and complete description to  
 "Annales de Chimie et Physique"

Page 1135 - Dec 21, 77. Experiments

"In order to collect the electricity produced  
the insulating material is removed from  
the iron in a narrow band around  
the outside of the ring and two rubbing  
collectors take it up much as in other  
machines already described."

"The tails of the radius bars are all  
grouped together round the central  
axis and they are rubbed against by  
suitable collectors which take up the  
electricity."

Page 1157 June 21, 1878. Machine  
Test at Franklin Institute, description of  
Brush, Wallace Farmer & Cranmer. —

"Upon the surface of the commutator  
rest bundles of soft iron wire by which  
the current generated in the armature  
coils are conducted to the external  
circuit" —

Engineer

Page 1118 June 21, 75-

"Brush"

"The commutator brushes which are  
 "composed of strips of hard brass  
 "joined together at their outer ends  
 "are inexpensive and easily renewed".

Page 296 Oct 25, 1878

Wallace Farmer Miskue, Illustrated  
 & described. - Reference to the figures for the  
 disposition of the brushes & commutator -

Page 329 Nov. 8, 1878

Gramme Machine illustrated &amp; described -

"Take any two diameters of this ring, at right  
 "angles the one to the other, and so place it that  
 "the ends of one diameter are just opposite the  
 "two poles of a permanent electric magnet. The  
 "inductive action of the magnet forms poles in  
 "the soft iron at the extremities of this diameter  
 "whilst the extremities of the other diameter are the  
 "poles where the opposing magnetisms meet,  
 "and here he establishes his brushes or collectors  
 "his currents."

Page 128 Aug 23. 78.

Report by Arncliffe, Thompson et al on  
Brush, Wallace & Kammie Machines

Page 113 Feb. 14, 1879

Illustrations & designs Edwin Lamb and  
Egnerata (Hart & Huntington) -

Page 349 May 16, 1879

Experiments and tests on Siemens Machine by  
Institution of Mechanical Engineers -

"The armature coil has fifty six divi-  
sions, and the brushes are single, not  
"divided, that is, each brush is in  
"connection with one segment of the  
"commutator at any instant" 12.79

11 1881

"The direction of displacement being  
 "the direction of magnetization and  
 "the amount of displacement the interior  
 "by of magnetization".

Page 222

"The magnetization at each point will  
 "be due not only to the external  
 "magnetic forces, but to the induced  
 "magnetism through the rest of the  
 "body — We may suppose each  
 "element of the mass magnetized  
 "along lines of force, the strengths  
 "of magnetization being given by the  
 "above formulas".

Page 276

"Having the lines joining these  
 "centers in the direction of magnetiza-  
 "tion

Summing Page 278<sup>71</sup>

"Suppose a sphere rigidly magnetized with intensity  $H$  placed with its lines of magnetization along the lines of force in the field."

Page 281

"If a small sphere of unmagnetized matter be placed in the field it will be magnetized along the lines of force."

Eng.

Phil Mag

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5. Karl Repertorium  
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II - 1851-574 - 2441, 443

Ger. Heidelberg. Verhandl. Nat. Med. Ver.

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VI 1822 - 83.85 - 220.224

Gene. *Acad. Soc. Lomb. Vindob.* (Bibl. 128 page 207)

I - 1831 - 278.250

IV 1834 - 67.80

II - 1832 166.169

Gene. *Modena Soc. Ital. Mus.*

XXI 1837 323.334

Gene. *Annali Giorn. Toscano.*

I. 1840 - 506.512

Eng. *Silliman Journal*XXXIII  
XXXII1838. 118.120.  
1837 1-8. (243) 317.317.Fr. *St. Petersb. Acad. Sci. Bull.* 1

I - 1836 121.125

Eng. *Ann. Phil Soc. Trans. Phil. Soc.*

I. 1818. 427.429

+ 1833 333.342

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VII - 1840 - 65. 78

an. Schirrigger Lomiv.

LVIII (= Jahrb. XVIII) 1830 273. 277.

an. Berlin Bericht. 1843 - 291. 299.  
1857 - 670. 674.

Am. Telegraph.

11. 1859 - 409. 413.

32. Bibl. Morris Archives

XXXIII 1856. 195. 213.

Engr. Tiltack Phil Mag.

XX

1800 - 159. 160

Gen. *Gubig Ann.*

LXXV

1850. 83, 94.

Gen. *Lond. Elect. Soc. Proc.* 1837, 40-183

<sup>Navy</sup>  
Gen. *H. Comenlo*

111-1545-225, 234

Phil. Mag. 1846 Pp. 449 89

Dr. Leach's armatures described by himself -

One consisted of a hollow tube of diameter 24 in. long  $1\frac{7}{8}$  in. diameter &  $\frac{3}{16}$  in. thick bent in shape of U - saw cut the entire length - each leg wound with 274 feet covered copper wire  $\frac{1}{10}$  in. in diameter -

The other armature consisted of two bars of iron each 20 in. long. 4 in. broad and  $\frac{3}{8}$  in. thick bent edge-ways in the form of a semicircle fastened together with the interposition of calico to prevent currents in the iron, each leg wound with two coils same size wire, the coils nearest the iron were 276 feet long the other coils 296 feet long -  
Placed between two straight steel

Refers also to Dr. Leousty -  
"Magical Investigations"

Magnets each 4 ft 4 in long 4 to 5 in square poles of  $7\frac{1}{2}$  square inches surface placed in a horizontal position with two of their poles connected by a suitable armature with the hollow armature, 500 turns per minute gave the maximum amount of decomposition -  $\frac{3}{4}$  cubic inches mixed gas per minute.

The flat semicircular armature at 500 Rps, gave 1.4 cu. in. gases per minute, and made to high red heat 2 in steel wire  $\frac{1}{8}$  in thick & fused 1 in same wire.

Results expected to be augmented by rotating the armature opposite the two poles of the magnets and not as in above case opposite their ends



Dr. Lamon in most advantageous form  
for magnets.

"Narrower magnets are more advantage-  
ous than broader.

"Thinner magnets are more advantageous  
than thicker.

"The most advantageous form is that  
in which breadth and thickness  
disappear and the magnet is  
transformed into a mathematical  
line i.e. into a so called linear  
magnet."

Two forms appear advantageous viz.  
"flat contracting to a point from the  
middle" and the flat prismatic.

— "There is only one means of obtaining  
great magnetic strength with lifting  
weights, namely, by firmly connecting  
several thin and flat magnets near  
or upon one another in one system with  
out their touching each other."

Dr. Menzies. Relation of the weight  
of a magnetizing space to the  
magnetizing force, —

"It is assumed that the maximum  
of intensity is in all cases obtained"  
"when the essential resistance, or that  
"offered by the battery, is equal to  
"the external resistance in the inter-  
"poler i.e. in this case the magne-  
"tizing coil". —

"The magnetizing power of two coils  
"which give the maximum of intensity  
"are as the square roots of their  
"weights" —

Phil Mag. 1868 - Page 235-

Lamin and Rogue in Magnets<sup>97</sup>  
 Elec machines

"Our machine consists of six rotating  
 plates each provided with sixteen  
 "teeth joined in tension and  
 "forming a total resistance  $R$  of  
 "twelve times of the rheostat. These  
 "plates are joined in quantity so as to  
 "form an electromotor of six inde-  
 "pendent machines sending their  
 "electricity into a common external  
 "circuit" - - from Comptes Rendus June  
 - 1, 1868 -

Phil. Mag. Pgs 405-1869<sup>99</sup>

On the limit of magnetization of iron  
and steel. Prof. Wallenhofen.

"The theoretically possible temporary  
magnetization of iron is more than  
"five times as much as the permanent  
"which has been attained by the best  
"steel magnets". — Sitzungsberichte  
der Kaiserlichen Akademie in Wien, 1869

Phil. Mag. 1873 Pgs 42

Dr. A. Stollon. On the magnetizing  
function of soft iron.

"If  $m$  is the magnetic moment of an  
extended ellipsoid of rotation which  
"is magnetized by a constant force  
" $X$  acting parallel to the polar axis."

Soulie's experiments in Phil Mag of 1847

Mayer on the effect of Magnetism  
in changing the dimensions of iron.  
1873 Vol XLV Page 350

Also on Page 1138 H. Wilde on some  
improvements in Electro Magnetic Induction  
machines

(Same) Phil. Mag. Page 48. 1873

"The induced electromotive force increases  
"proportionally with the number of secondary  
"turns. That it depends only on the number  
"and not on the quality of the turns."

- The above are some References taken  
from the Note Books, corresponding in  
possession of Dr. Moser.

Phil Mag. 1861. Vol. 19. Page 320

Electric Light for Lighthouse Illumination

- Edison's machine for light in South  
Portland High Light.

"The wires of the helices are conjoined and  
"connected with a commutator, which,  
"as the magnet wheels are moved round,  
"gather the various electric currents pro-  
"duced in the helices and sends them  
"up through two insulated wires in  
"one common stream of electricity into  
"the light house lanterns."

Phil Mag Vol 20, 1860. Pgs 45-8 103

"On the Molecular Changes produced  
by Magnetization - by W. Beetz.

Translated from Poggendorff's Annalen"

"It is impossible to obtain a brick magnet  
"as completely saturated as a thin one".

"There never can be a magnet completely  
"saturated with temporary magnetism."

"The most powerful magnetizing currents  
"will never be able to bring the axes of  
"the particles into perfect parallelism  
"with each other."

Vol 21, 1861 Pages, 65-92-250

Prof. Graham on a Theory of Magnetic Lines

Vol 21, 1861 Pgs 161, 251, 338. (Contd)

Maxwell On physical lines of force

Vol 21, 1861, Pgs 511

Some results in electric magnetism obtained  
with the balance galvanometer by G. B. Blair.



Phil Mag Vol 27. 1864. Page 506 <sup>cont</sup> 107

"On the electric currents induced by a  
"Magnet in a rotating conductor.  
by E. Jochmann - from Journal für die  
reine und angewandte Mathematik Vol  
LXIII p 158.

Continued in Vol 28. page 347.

Phil Mag Vol 29. 1865 page 113

On an Anomalous Magnetizing Action  
by Prof. A. von Wallenhopfen. Translated  
from Bericht der Kaiserlichen Akademie  
der Wissenschaften

Same vol page 152

A Dynamical Theory of the electric  
Magnetic field by J. Clerk Maxwell.

Vol. 32 Page 148

Experimental Researches in Magnetism  
and Electricity by H. Wilde Esq.

"On a Magnet cylinder of Brass or iron  
with internal diameter of  $1\frac{1}{8}$ " inches  
be placed one or more permanent



"Horse shoe magnets, An armature 109  
 "was made to revolve rapidly, in  
 "the interior of the cylinder in close  
 "proximity to its sides but without  
 "touching, Around this armature 163  
 "feet of insulated copper wire was  
 "soldered 0.03 of an inch in diameter and  
 "the free ends of the wire were connected  
 "with a commutator fixed upon the  
 "armature axis for the purpose of taking  
 "alternating currents of electricity from  
 "the machine in one direction only."

Two magnet cylinders were made  
 "and filled with an armature, round  
 "which was coiled an insulated  
 "strand of copper wire 67 feet in length  
 "and 0.15 of an inch in diameter."

"A 10 inch electro magnetic machine  
 was constructed; the weight of its electro  
 magnets is nearly 2 tons, and the  
 total weight of the machine about  
 4 1/2 tons. The machine is furnished

"with two armatures, one for the<sup>111</sup>  
 "production of intensity" and the other  
 for the production of quantity effects.  
 "The intensity armature is coated  
 with an insulating conductor consisting  
 of a bundle of thirteen No. 11 Belpaire  
 wires each 0.125 of an inch in diam-  
 eter. The coil is 3 1/2 feet in length  
 and weighs 232 lbs."

"The quantity armature is envelop-  
 ed with the folds of an insulated  
 "copper plate conductor 67 feet in  
 "length the weight of which is 344  
 "lbs." Armatures driven 1500 Revs  
 per minute.

Vol. 32 - Pages 378 & 433

Remarks on the Dynamical theory of  
 electricity by G. Brooke,

Vol 32 Page 457.

On the influence of magnetization  
 on the length and the resistance of  
 iron bars" by Prof W. Beech

Phil Mag Vol 33. 1887. Page 63

J. R. Robinson on increasing the <sup>113</sup> electricity given by Induction Machines

"The secondary helix may be made  
"of longer or thicker wire - the length  
"does not increase the quantity of  
"the current at all - the effect of  
"the thickness is limited" -

"The analogy of the battery suggests  
"combining several helices solenoidally,  
"as is done when cells are arranged  
"for quantity."

Vol 33. Page 469

Mr. G. W. Siemens on the conversion of  
dynamical into electrical force without  
the aid of Permanent Magnets

"An electric magnetic machine consisting  
"of one or more horse shoes of soft  
"iron surrounded with insulated wire  
"in the usual manner, & a rotating  
"disk of soft iron surrounded also

"with an insulated wire and of  
a commutator connecting the  
respective coils in the manner of  
a magneto electric machine,"

Vol 33 Page 471.

On the augmentation of the power  
of a magnet by the relation between  
of currents induced in the magnet  
itself. Charles Wheatstone

"The core of the electro-magnet is formed  
of a plate of soft iron 15<sup>in</sup> in length  
and  $\frac{1}{2}$  an inch in breadth, bent at  
the middle of its length into a horse-  
shoe form. Round it is coiled in  
the direction of its breadth 600 ft  
of insulated copper wire  $\frac{1}{2}$  of an  
inch in diameter. The armature  
consists of a rotating cylinder of  
soft iron 8 $\frac{1}{2}$  inches in length  
grooved at two opposite sides so  
as to allow the wire to be coiled  
upon it longitudinally; the

"Length of the wire thus coiled  
 "is 80 feet and its diameter the  
 "same as the electric magnet coil".  
 — "Stronger effects are produced at  
 "the first moment of completing  
 "the combined circuit than otherwise."

Vol 33 Page 271

On the theory of Maintenance of  
 electric currents by permanent  
 magnets written by Dr. Hermann  
 Wagner, by J. J. Thomson.

Vol 33 Page 523

C. F. Varley, on certain points in the  
 theory of the magnetic electric ma-  
 chines of Wilde, Lillie and  
 Siemens—

"An opportunity afforded me of ex-  
 perimenting with Mr. C. Siemens ma-  
 chine, in which the electric magnets  
 have each a resistance of about  
 $250 \text{ ohms} = 510 \text{ ohms}$ , the armature  
 $400 \text{ ohms}$ .

Phil Mag Vol 33. 1867 Page 544  
 On a Magneto electric Machine  
 by Mr Ladd.

Phil Mag Vol 34. 1867 Page 81  
 Experimental researches in Magnetism  
 and Electricity by H. Wilson.

"If round the piece of iron forming  
 the armature of a permanent  
 magnet a quantity of insulated  
 wire be wound at right angles  
 to the line which joins the poles  
 of the magnet and if the free ends  
 of the wire be connected together  
 directly or indirectly by the inter-  
 position of some conductor, "a  
 momentary wave of electricity  
 is generated every time the arm-  
 ature is made to approach or  
 recede from the magnet."

272 Broke examined on <sup>May 14 1881</sup> Dynamo  
Machines etc. = "Line of Magnetization"  
1 Higgs. — 2 Sawyer. — 3 Peck  
4 Schoolbred. — 5 Sprague.  
6 Engineering <sup>22</sup> / Jenkins 1879  
8 Engineer 1869 to 1881. — 9 Lammings  
10 American Cyclopaedia. —  
"For Dynamo Machines generally  
Physiological Magazine.

Phil Mag. 1860 Vol. 19. Pp 241

"A large receiver in which a vacuum had  
been obtained by filling it with carbonic  
acid gas, exhausting it, and permitting  
the residue to be absorbed by caustic  
potash" was placed in

Phil Mag Vol. 23. Pp 13. A

"A charge of electricity has been passed  
(by W. Thompson) in a glass vessel for  
years without penetrating the thickness  
of the glass."

Phil Trans. 1832 Pp 32. Faraday



Menlo Park Notebook #214 [N-81-02-20]

This notebook covers the period February-July 1881. The entries are by Charles L. Clarke and relate to dynamos. Included are notes, calculations, and drawings of the Porter-Allen central station dynamos, the South American portable dynamo, sizes E, F, and C dynamos, a steamboat dynamo, and a flywheel for an Armington-Sims steam engine dynamo. Thirteen loose pages found in the book contain additional notes, drawings, and calculations. The label on the front cover is marked "C. L. Clarke" and "Magnets." The book contains 278 numbered pages.

Blank pages not filmed: 72-99, 104-109, 224-253, 268-269, 278.

Calculations for C. J. Clarke. 1  
 South American  
 Portable Dynamo. Feb. 20, 1881

Dynamo with  $10\frac{1}{4}$ " field  
 diameter.

By the test of Jan.  
 29, 1881 the E.M.F. on  
 lamps was  $164 \times \overset{\text{Volts}}{.675}$   
 = 110.7 Volts. **A**

The E.M.F. in magnet-  
 circuit was (30.95 ohms  
 resis.) 240 volts.

Of this resis. 17.05 ohms  
 were in the magnets,  
 the remainder being  
 in the regulating resis-  
 tance.

The E.M.F. in the magnets  
 was therefore 132.2 Volts.

and with 11 magnets in <sup>3</sup>  
series the fall in each  
was 12 volts.

which corresponds to a  
deflection in the high  
resistance galvanometer  
in this case of  $17.8^\circ$ .

The deflection of  $164^\circ$   
corresponds to an average  
speed of 1203 revs. per  
minute and at 965 revs.  
the deflection would be  
 $131.6^\circ$

This with  $17.8^\circ$  on the  
magnet corresponds  
closely with experimental  
curves determined Dec. 10  
1881.

Each core has 690 turns<sup>5</sup>  
in 3 layers of No. 10 copper  
wire and average distance  
diameter of 6.456 feet. inner  
Length of one turn

$$6.456 \times 3.1416 = 20.28 \text{ inches}$$

Total length on both

$$\text{cores } 27986.4 \text{ inches}$$

$$= 2332.2 \text{ feet.}$$

The resistance is

$$\frac{10.64 \times 2332.2}{(130)^2} = 1.38 \text{ ohms.}$$

The wire was  
not exactly No. 10  
of 134 diam. but  
130 diam.

With an assumed con-  
ductivity of 97.

The weight of the wire

$$\text{is } 2332.2 \times 0.054353$$

$$= 126.76 \text{ lbs. but since}$$

wire was 130 diam.

$$= 119.3 \text{ lbs.}$$

If the armature were  
single wound instead of  
double the E.M.F. would  
have been 55.35 Volts.

Suppose

$T$  = turns of wire

$C$  = Current

$E$  = E.M.F.

$R$  = resistance

Then Efficiency =  $C \times T$

and Energy =  $C^2 \times R$

If wire is of half the  
cross section but same  
weight  $r = 4R$ .

$t = 2T$

Efficiency =  $c \times t$ .

which assume to be the  
same as before

$\therefore c \times t = C \times T$

but  $t = 2T$

$$\therefore C = \frac{C}{2}$$

$$\begin{aligned} \text{Energy } C^2 R &= \frac{C^2}{4} \times 4R \\ &= C^2 \times R \end{aligned}$$

The amount of energy in the two cases is therefore the same.

To produce however half the current  $C$  though four times the resistance  $R$  requires an E.M.F.

$$= 2E$$

Therefore with a given weight of copper and a constant efficiency and constant energy

$$E.M.F. \propto T$$

$$C \propto \frac{1}{T}$$

$$R \propto T^2$$

Also

$$\text{Cross-section of wire} \propto \frac{1}{T}$$

Efficiency  $\propto (\text{diam. of core})^{\frac{1}{2}}$ ,

Efficiency  $\propto (\text{length of core})^{\frac{1}{2}}$ .

The present dynamo gives 55 volts at the speed of 1203 revs. ~~at~~ near the saturation point which would not be well to regulate automatically. A lower point on the curve of magnetism should be taken where the curve is approximately a straight line, say at the point where at 965 revs. the E.M.F. is 39.15 volts with 7.425 <sup>6.75</sup> volts in the magnet. At 1203 revs = 48.8 volts

If  $x$  is the product of the length by the diam. of core

$$\sqrt{x} : 55 :: \sqrt{36 \times 6} : 48.8$$

$$\therefore x = 275 \text{ approx.}$$

If the core is steel kept 6" diam. the length will be 46 inches.

If  $6\frac{1}{2}$ " diam.  
length  $42\frac{1}{2}$ ".

The size of cores will be  $6\frac{1}{2}$ "  $\times$   $42\frac{1}{2}$ ".

but  $\frac{1}{2}$ " will be added to the length to allow for fiber and iron washers.

The yoke will be  $6\frac{1}{2}$ " deep by  $7\frac{1}{2}$ " wide.



The field wire retains its 15  
~~present dimensions~~  
~~9 1/4"~~ be 9 1/2" wide.

Amount of copper 120 lb.

On each core 60 lb.

The energy required to be  
 developed in entire magnet  
 circuit is

$$\frac{5.75^2}{1.47} \times 44.3 = 1373 \text{ ft.-lb.}$$

On the cores to separate  
 the coils from the yokes  
 and poles must be  
 placed fiber rings.

---

Feb. 21, 1881

Clark<sup>17</sup>

Suppose no resistance in  
the magnet circuit other  
than the coils in the  
magnet itself the resist-  
ance required to give the  
energy of 1373 ft.-lb. on  
55 volts will be

$$\frac{55^2 \times 44.3}{1373} = 97.6 \text{ ~~Volts~~ ohms.}$$

or current - 5.63 rebers.

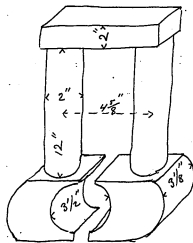
~~The small magnet intended  
for the regulation has a  
core 18" long by 3" diam.  
and this must be at all  
times saturated~~

See page 37 for con-  
tinuation of resistance.

For regulator use a magnet  $\frac{1}{3}$ <sup>rd</sup> the size of the medium machines.

Core  $1\frac{1}{2}$ " long  $\times$  2" diam.

Yoke 2"  $\times$



Let the amount of copper be in proportion to that on the medium machines which have 120 lbs. The

amount for the regulator 21  
will be  $\frac{120}{27} =$

Armature

Feb. 21, 1887 23.

Clarke

The field will be  $10\frac{1}{4}$ " diam.

Clearance between field  
and armature binding wire  
 $\frac{3}{100}$ ".

Diam. of brass or German  
silver binding wire  $\frac{2}{100}$ "  
(Number 25 B.W.G.)

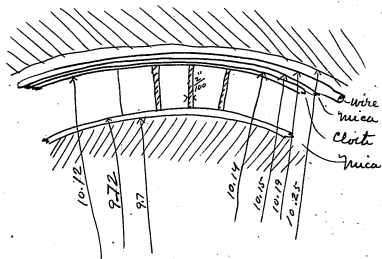
Mica under binding wire  
 $\frac{5}{1000}$ " thick

Cloth covering under mica  $\frac{10}{1000}$ " thick

Mica over armature and  
under copper rods  $\frac{10}{1000}$ " thick

Depth of copper rods on  
armature  $\frac{2}{10}$ ".

Diam. of armature core  $9\frac{7}{10}$ ".



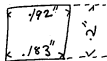
Diameters

The 50 divisions of the armature  
are on an outer ~~radius~~ <sup>radius</sup> of 10.12  
and inside diameter of 9.72.

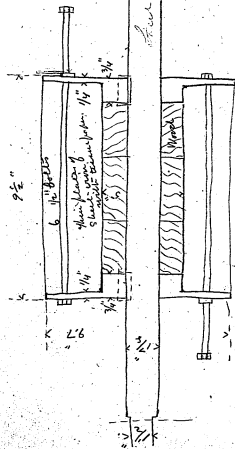
Width of 1 division on  
outside diam. .212"

ditto inside .203"

With a separating insulation  
of  $\frac{2}{100}$ " the actual width  
becomes .192" and .183".



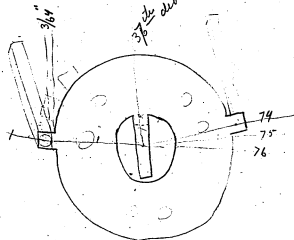
See page 53 for  
Commutator blocks.

$\frac{1}{2} \times \frac{3}{4}$ 




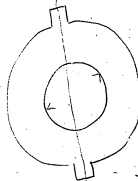


150 divisions

 $37\frac{1}{2}$  divisions in 15075 blocks with  $\frac{1}{2}$ " insulation

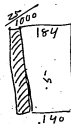
$$\begin{array}{r}
 3.1416 \\
 \hline
 75 \overline{) 15.7080} \quad (2094 \\
 \underline{15.0 \times \times \times} \\
 708 \\
 \underline{675} \\
 330
 \end{array}$$

$$\begin{array}{r}
 -2094 \\
 \underline{.025} \\
 .184
 \end{array}$$



$$\begin{array}{r}
 3.1416 \\
 \hline
 75 \overline{) 12.5664} \quad (.1675 \\
 \underline{7.5 \times \times \times} \\
 506 \\
 \underline{450} \\
 566 \\
 \underline{525} \\
 414
 \end{array}$$

$$\begin{array}{r}
 .1675 \\
 \underline{.025} \\
 .1925
 \end{array}$$



Commutator blocks

From page 17.

The ft. lbs. actually required  
to saturate the medium sized  
magnets is

$$\frac{20 \times 675}{1.47} \times 44.3 = 5492 \text{ ft. lbs.}$$

but with the magnet  $\frac{1}{2}$  inch  
larger in diam. and length  
7" greater and also consider-  
ing the fact that the E.M.F.  
will be of the required in-  
tensity some distance down  
the curve from the saturation  
point (only 1373 ft. lb.

being actually required)  
we will assume 3500 ft.  
lbs. as required of which  
the half may be used up  
in <sup>regulating</sup> resistance but actually  
the effect will be by  
Counter E.M.F. of the regulating  
motor.

The necessary resistance  
will be

$$R = \frac{55^2 \times 44.3}{3500} = 38 \text{ ohms}$$

If  $L$  is the length of conductor  
and  $D$  the diam. in thousandths  
of an inch

$$R = 38 = \frac{10.64 \times L}{D^2}$$

but weight is 120 lb. and  
mil-foot weighs .000003027

$$\therefore D^2 \times L \times .000003027 = 120$$

$$L = \frac{120}{.000003027 D^2}$$

$$\therefore 38 = \frac{10.64 \times \frac{120}{.000003027 D^2}}{D^2}$$

from which

$$38 D^2 = \frac{10.64 \times 120}{.000003027 D^2}$$

$$\therefore .000115026 D^4 - .0000322073 D^2 = 120$$

$$\therefore D^4 - .28 D^2 = 1043240$$

$$D^4 - .28 D^2 + .0196 = 1043240.196$$

$$D^2 - .14 = \pm 322.79$$

$$\therefore D^2 = 323.13$$

$$D = 322.85$$

$$\therefore D = 17.975$$

$$or = 17.968$$

Assume No. 26 B.W.G.

$\frac{18}{1000}$  "diam:

Suppose the weight in a rod 1<sup>ft</sup> long - 120 lbs.

Since a mile-foot weighs .000003027 there would be 120 ÷ .000003027 = 396432 1/100 miles in the rod.

For a constant weight of metal Resis.  $\propto$  (Length)<sup>1/2</sup>.

Resis. of this rod is  $\frac{1064 \text{ ohms}}{396432/100}$

but since the resistance is to be 38 ohms the length L

$$L = \left( 38 \times \frac{396432/100}{1064} \right)^{1/2}$$

$$\therefore L = (141582.896)^{1/2} = 11898 \text{ feet}$$

The mils in cable vary inversely as  $L$ , therefore the

$$\text{Circum Mil's} = \frac{39643211}{11898}$$

$$= 3332.48$$

$$\text{Diam.} = \frac{(3332.48)^{\frac{1}{2}}}{1000} = \frac{57.7}{1000}''$$

By taking No. 17, B.W.G. =  $\frac{58}{1000}$   
the resistance number of feet will be 11784.5 feet.

The resistance

$$R = \frac{10.64 \times 11784.5}{(58)^2} = 37\frac{1}{4} \text{ ohms.}$$

See p. 51.

Since on  $37\frac{1}{4}$  ohms 1373 ft. lbs. are required <sup>at this length</sup> to be developed, the weight of copper not having been altered, the E.M.F. necessary

$$E = \frac{(1373 \times 37\frac{1}{4})^{\frac{1}{2}}}{44.3} = 34 \text{ volts.}$$

55 volts being all required<sup>45</sup>  
 of the machine at this  
 point - the <sup>total</sup> remaining  
 resistance for regulation  
 will be  $\frac{55 \times 37\frac{1}{4}}{34} = 60\frac{1}{4}$  ohms

The regulating resistance  
 outside the magnet will  
 be  $60\frac{1}{4} - 37\frac{1}{4} = 23$  ohms.

To have a margin and  
 for making the lights  
 less brilliant - introduce  
 20 ohms extra making in  
 all 45 ohms in boxes.

If made of German  
 silver wire of  $\frac{32}{1000}$ " diam.  
 No. 21 B.W.G. the necessary  
 length will be

$$L = \frac{45 \times 32^2}{10.64} \times \frac{1}{7} \\ = 620 \text{ feet.}$$



See page 49.

If we have 5 boxes of 1 ohm<sup>47</sup> each the length of wire on each will be 15.5 feet and on each of the 5 ohm boxes (of which there will be 8) 77.5 feet.

If boxes are 3" square there will be 1 ft. for a turn and 8 threads to the inch the height of boxes will be 9.7 inches. This will enable them to be placed in a box 1 ft high.

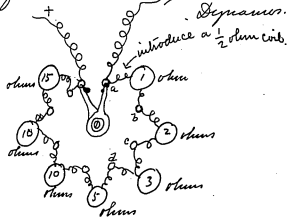
The 5 coils of 1 ohm each can be wound on 1 of the boxes for 5 ohm coils.

The box would be a cube of 1 ft. Must have holes for an circulation.

Feb. 24, 1881

Clarke.

Resistance box for regulating  
field for South American  
Dynamometer.



The total length of wire will  
be 620 ft. or  $13\frac{1}{2}$  ft.  
to the ohm.

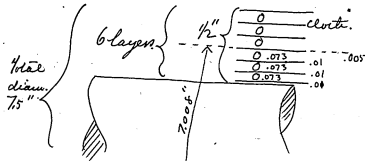
a, b, c, d,  $\frac{e}{f}$  must be so  
close that the switch will  
span the space and circuit  
never be broken.

See page 57

If 17 B.W.G. is used on the magnet, the diameter of .058" will be increased by the double cotton insulation to ~~.134~~ \* .073".

There are 42" of available length in the core.

This gives 575 turns to a layer



With six layers the diameter (mean) will be  $6.5438 = 6 \times .073$   
 $.07 = 7 \times .01$   
 7.008 inches

The total length will be 12650 feet and the

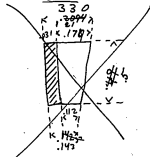
resistance

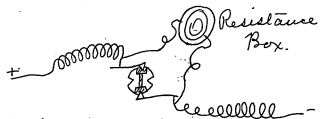
$$R = \frac{10.64 \times 12650}{582}$$

$$= 40 \text{ ohms.}$$

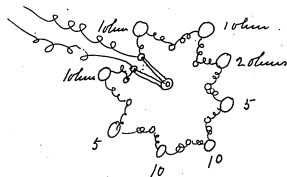
Commutator 5" diam.

$$\begin{array}{r} 3.1416 \\ 75 \overline{) 15.7080} \end{array} \begin{array}{l} 2094 \\ 150 \times \times \times \\ 708 \\ 675 \end{array}$$

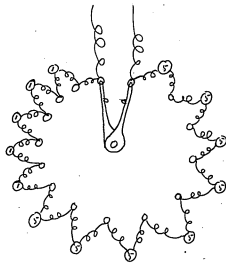
See page  
35.



This arrangement  
controls each resistance.  
As also does an ordinary  
plug.



See page 57.





Resistance of the South  
American machine (55 Volts).



The cross section is  

$$\left( \frac{.192 + .183}{2} \right) \cdot 2 = .0375 \text{ sq. in.}$$

Size / mil. (circular) is

$$.0000007854 \text{ sq. in.}$$

The no. of circular mils will  
 be  $\frac{.0375}{.0000007854} = 48001 \text{ cir. mils.}$

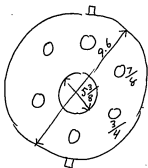
The mean length of the rods  
 is  $\frac{(14.158 + 14.197)}{2} = 14.178 \text{ inches}$   
 $= 1.1815 \text{ ft.}$

The resistance of this part of  
 the circuit will be

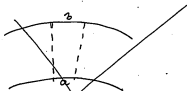
$$R = \frac{10.64 \times 150 \times 1.1815}{4 \times 48001}$$

$$= .009821 \text{ ohms.}$$





Mean <sup>diam</sup> radius of copper  
plates 7.4875



If any element of a ring  
is taken and at  $a$  we  
have for unit length  $l$  a  
unit length weight  $w$  of  
metal  $\propto l \propto r$   
and mean length in this  
diam. = 23.5"

Depth of rings 2" 11.25

thickness .028

Approximately the cross  
section is  $2.1125 \times .028 = .059$

for 18.5 inches

~~2.1125~~

~~$1.2375 \times .028 = .03465$~~

for 1.875 inches

~~$1.3625 \times .028 = .0383$~~

for 2.25 inches

For the diminishing of  
the cross section by the  
holes increases length to  
25 inches = 2.083 ft.

In .059 sq. in. there will be

$\frac{.059}{.000007854} = 75121$  cir. miles.

$$R = \frac{10.64 \times \overset{75150}{75121} \times 2.083}{8 \times 75121}$$

= .0155 turns

The total resistance  
will be see pages 61 & 65

$$.00982 + .0155$$

$$= .0253 \text{ ohms.}$$

The  $\frac{14}{100}$  machine will run  
50 A. 16 lamps and that  
is about the limit on account  
of heat. 115 ohms each.

$$\frac{115}{50} = 2.3 \text{ ohms.}$$

110 volts.

$$\frac{110^2}{2.3} \times 44.3 = 233057 \text{ ft. lbs.} \quad (7.06 \text{ H.P.})$$

The amount developed, as  
heat, in the machines will  
be  $\frac{14}{230}$  of 233057 = 14186 ft. lbs.

$$\text{Total } 233057 + 14186 = 247243 \quad (7.5 \text{ H.P.})$$

Ratio of external to  
internal 14.4 to 1.

The South American machine<sup>69</sup>  
has a resis. of .0253 ohms.

The B. 16 light has the same  
radiating surface as the

A. 16 and with  $\frac{1}{2}$  the  
E.M.F. (or 55 volts) and  
same length as B. 8 it  
has the same foot-lb.  
of energy - Therefore the  
energy will be (page 67)  
for 50 lamps 233057 ft. lb.

. The resis. external is

$$\frac{115}{4 \times 50} = .575 \text{ ohms and}$$

internal is .0253 The  
heat developed in armature  
will be

$$\frac{253}{5750} \text{ of } 233057 = 10254 \text{ ft. lb.}$$

Ratio of external to internal  
22.75 to 1.

In order that as much heat<sup>71</sup>  
may be developed in the  
armature in the last case  
as with the  $\frac{14}{100}$  dynamo  
with A 16 lamps we must  
have (The ft. lb. for each lamp  
being  $\frac{233057}{50} = 4661$  ft. lb.)

If  $x$  = number of lamps  
the external resis. is

$$\frac{115}{4x} - .0253 \quad \text{if } 4661x = 14186 \text{ ft. lb.}$$

$$.1012x \times 4661x = 115 \times 14186$$

$$471.6932x^2 = 1631390$$

$$x^2 = 3459$$

$$x = 59 \text{ lamps.}$$

## Dynamo B.

The size of dynamo A is larger than what is absolutely necessary for the given E.M.F. but it was increased so as to make automatic regulation better by being on the straight portion of the curve of magnetization.

At  $\frac{965}{1200}$  revs. the deflection is  $131.8^\circ$  which would give at 1200 revs.  $163^\circ$  def. = 910 Volts.

This corresponds to a def. on the magnet of  $140^\circ = 9.45$  Volts. This is a good point on the curve for economy and regulation. The energy required on the magnets will be 2691 ft. lbs.

The field of the dynamo  
in experiment have a width  
of  $9\frac{1}{4}"$  which we will reduce  
to  $9"$  or by  $2.7\%$  but this  
can be more than made  
up in decreasing the diam.  
of the iron of the core.

The iron of the armature has  
been  $9.7$  outside radius and  
 $5$  inside and area is ex-  
pressed by  $(9.7)^2 - (5)^2 = 69.09$   
But inside radius can be  
decreased to at least  
 $3\frac{3}{8}"$  then  $(9.7)^2 - (3\frac{3}{8})^2 = 82.7$   
an increase of  $5\%$ , thus  
more than counteracting the  
effect of decreased width  
of poles.

Also see 265' page 111

# Central Station Dynamo.

March 29, 1881.

In the Porter-alien dynamo  
by increasing the commutator  
from 69 to 75, the speed  
may be reduced to

75 : 69 :: 600 : 552

No. rev.

with 75 comm. = 552

By increasing the length of  
armature from 28" to  $33\frac{3}{4}$ "  
the speed may be reduced  
to 33.75 : 28 :: 552 : 458

No. rev. = 458

Arm.  $33\frac{3}{4}$ " long



To reduce the revolutions  
from 458 to 350 the  
diam. must be increased  
by a ratio of  
 $1: x :: 350:458$

Ratio of increase  
of diam. of  
armature  $= 1: 1.30857$

Actual necessary diameter

$$1.30857 \times 19.46$$

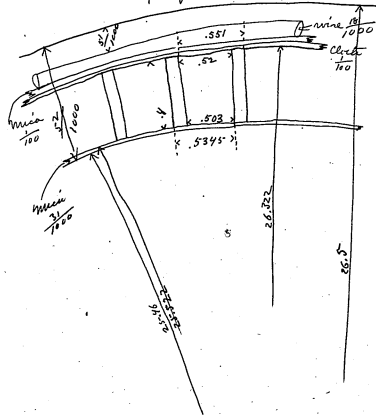
$$= 25.46$$

If the space remains the  
same as before  $\frac{52}{100}$ " the  
diam. of field will be  
 $= 26.5$ "

$$\begin{array}{r} 21.03 \\ 20.868 \\ \hline 2.162 \\ .031 \end{array}$$

$$\begin{array}{r} 25.46 \\ .62 \\ \hline 25.822 \end{array}$$

See page 129 for correct sketch



The diam. on the mica insulation is 25.522 and circumference 80.1799152 and with 150 bars the space for each on this diam. will be .5345 inches.

With  $\frac{1}{32}$ " insulation the bottom width of rod will be .503 "

Assume the rods as .40 deep, the diam. on outside diam of armature rods is 26.322 and circumference 82.693 and with 150 bars the space for each on this diam. will be .5513

With  $\frac{1}{32}$ " insulation the top width of rod will be .52

In the Porter-Allen Dynamo<sup>119</sup>  
the following are dimensions  
of armature rods



And number of commutator  
blocks 69. length 28"

In Central Station Plant



75 commutators, length  $33\frac{3}{4}$ "  
+  $7\frac{3}{4}$ " with plates .065 thick  
and insulation .02 thick.

$$\text{Resis.} = \frac{10.64 \times 25.6.25}{260441}$$

$$= .01047$$

Entire resis. of armature

$$= .005235 \text{ ohms.}$$

Q. R. March 30, 1881-121

By reducing the no. of  
commutator to 73. the  
diam. should be increased  
from 25.46 to

$$73 : 75 :: 25.46 : 26.16$$

$$= 26.16$$

Which we will increase  
to 26.46

$$\text{Circumference} = 83.126736$$

With 146 armature bars  
the space for each at bottom

$$\frac{1}{146} = .56936 \text{ and}$$

with  $\frac{1}{32}$  insulation,

actual bottom width

$$= .538$$

Outer circumference  
of armature rods with

27,322 drain.

$$= 85.8347952$$

Wp space for each of 146

$$\text{rods} = .5879$$

With  $\frac{1}{32}$ " insulation

$$= .557$$

$$\text{Area} = .21929 \text{ m.}$$

$$= 278839 \text{ c. mils.}$$



Length of each rod 41 inches  
and total of 74673

$$= 498.83 \text{ feet}$$

$$= 249.415 \text{ ''}$$

$$\text{Resis} = \frac{10.64 \times 249.415}{278839}$$

$$= .00952$$

$$\text{Total resis} = .00476 \text{ ohms.}$$

$$\frac{600}{3}$$

$$\frac{350}{600} \times 26$$

$$600 \times 20$$

With 120 Horse power outside <sup>125</sup>

$$\frac{110}{R} \times 44.3 = 3960000$$

$$R = .13536 \text{ inms.}$$

Ratio of armature rods to

$$\frac{\text{External}}{\text{Internal}} \frac{.00476}{.13536} = \frac{1}{29}$$

~~Ratio of armature rods to~~

~~external~~

$$\frac{.00476}{.1306}$$

$$= \frac{10}{274}$$

In the  $\frac{14}{100}$  dim machine the loss of energy with 50 lights will be as follows -

Resis. ~~110~~  $\frac{50}{115}$  outside with 110 volts drop gives

$$\frac{50}{115} : 110 :: \frac{4}{100} : = 10.12 \text{ Volts.}$$

$$\frac{10.12^2}{\frac{14}{100}} \times 44.3 = 32400 \text{ ft. lb.}$$

Armature has the two ends and face to radiate from  
 $= 10\frac{1}{4}$  diam.  $9\frac{1}{4}$  length  
 $= 463 \text{ sq. in.}$

$$\frac{32400}{463} = 72 \text{ ft. lbs. per sq. in. to radiate.}$$

Large Armature rods.

See page 123. Circumference  
 $= 85.835$

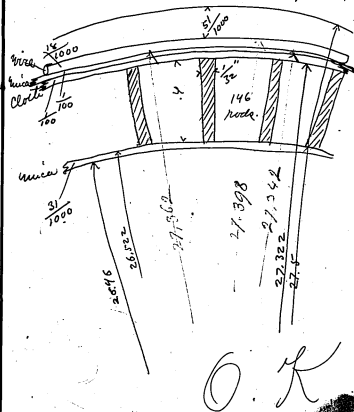
Surface  $= \times 41 = 351.9 \text{ sq. in.}$

$$\frac{136552}{3520} = 31 \text{ ft. lbs. per sq. in. to radiate.}$$





March 30. 1881.

Correct Central Station  
Dynamo.Copper wires  $\frac{68}{1000}$   
Insulating paper  $\frac{22}{1000}$ 

In the Portin-Allen dynamo  
with a ratio of internal  
resis. to external of 1/5.22  
the fall of E.M.F. in arma-  
ture is 5 volts, making  
a total necessary of  
115 volts. To obtain this  
at 600 revs. the point on  
the magnetization curve  
is economical.

The current required to  
effect this is  $\frac{75^\circ \times 675}{23} =$

2.201 rebs.

For a margin against  
deflection of

The no. of turns on a  
magnet is 3720 and  
product  $2.201 \times 3720$   
= 8187.72

23) 116(5

With new helices. 4<sup>th</sup> 6"  
 instead of 3<sup>th</sup> 6" as in  
 Porter-Allen Dynamos  
 the no of turns will in-  
 crease in the ratio of  
 42" 6-5-4"

$$= 4783 \text{ turns}$$

Assume that 100 volts will  
 give the current of 2.201  
 rebers. we must have  
 a resistance of

$$\text{Circuit } 100 \div 2.201 = 45.5 \text{ ohms.}$$

To get the same current  
 through 4783 turns of 45.5  
 ohms as through 3720  
 turns of 23 ohms  
 requires a ratio in  
 diam of copper



~~10.64~~

$$R = \frac{10.64 \times 4783}{x^2} = \frac{15^4}{4783}$$

$$r = \frac{10.64 \times 3720}{(109)^2} = 23.$$

$$\frac{(15^4)}{4783} x^2 = \frac{23 \times (109)^2}{3720}$$

$$x = 15.4$$

The wire nearest to this is  
No. 8 =  $\frac{165}{100}$  and with  
insulation would be  $\frac{19}{100}$   
With cores 40 large.

With wire .130 and insu-  
lation .025, total diam. = .155  
4783 turns can be got in 4'6"  
Cores with 7 layers

—03  
00000000  
00000000  
00000000  
00000000  
00000000  
00000000  
00000000

Suppose 8" cores

Unit

8.170  
9.170

Total drain

$$8 + (1.17)^2 + (.03)^2 \\ = 10.4 \text{ inches}$$

but distance between  
center is  $11\frac{1}{4}"$ .

Therefore, 85" clearance  
between.

Mean drain of copper  
wire is 9.17

Circumference 28.808

Total length =

$$4783 \times 3 \times 28.808 \\ = 413365.992 \\ = 34447.166 \text{ feet}$$

$$\text{Resis} = \frac{10.64 \times 34447.166}{730}$$

$$= 21.7 \text{ ohms.}$$

Correct.

With wire .148 and insulation  
 .025" Total drain = .173

0 173  
 01  
 0 173  
 01  
 0 173  
 01  
 0 173  
 01  
 0 173  
 01  
 0 173  
 01  
 0 173  
 03

8 1.301  
 1.301  
 9.301

1.301  
 2  
 2.602

.06  
 8.  
 10.662

Drain = 10.662 "

Clearance = 11.25 - 10.662

= .588

Mean drain. of copper  
 wire = 9.301

Circumference = 29.22

Total length of wire

$$= 4370 \times 3 \times 29.22$$

$$= 383074.2"$$

$$= 31922.85 \text{ feet}$$

$$\text{Reas} = \frac{10.64 \times 31922.85}{798^2}$$

$$= 15.6 \text{ turns.}$$

O. K. See page  
143

Length of Armature  
33  $\frac{3}{4}$ "

Diam. of " 26.46

" " poles 27.322

Length of cores 4  $\frac{1}{2}$  7"

Diam. of cores 8"

|       |          |
|-------|----------|
| .159  | ○        |
| .01   |          |
| .159  | ○ No. 10 |
| .01   |          |
| .159  | ○        |
| .01   |          |
| .159  | ○        |
| .01   |          |
| .159  | ○        |
| .01   |          |
| .159  | ○        |
| .03   |          |
| <hr/> |          |
| 81    |          |
| 9.034 |          |

Mean diam 9.034

3.1416

54.204

36.7936

27.9034

28.3872

Each turn 28.3872

340 turns in a layer

2040

4080

turns on a magnet

= 9649.2 feet

and for three magnets

28948

28948 X .054353 = 1573 lbs.

.054353

Thickness of discs .065 143

" " insulation .020

See page 141 for lengths of  
wire = 31922.85 feet.

31922.85 X .066303

= 2117 lbs.

For the Buckeye

With 6 layers of No. 10  
wire the no. turns in  
each layer = 2040

Total length = 28952 feet

Resis = 16.7 ohms.

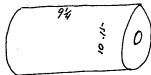
Weight

28950 X .054353 = 1573 lbs.



# Steam boat dynamos.

The medium sized machine having a resistance of  $\frac{14}{100}$  ohms has an armature of the dimensions outside of wire



Circumference = 31.887"

Radiating surface of face  
= 295 sq. in.

With 50 lamps of 115 ohms resist. the joint resist. is  $\frac{115}{50}$   
= 2.3 ohms and internal resist. is .14 ohms. With 110 volts outside the drop inside

will be 6.7 volts

Total energy lost in armature

$$\frac{6.7^2}{.14} \times 44.3 = 14205 \text{ ft. lb.}$$

If this energy has is radiated  
as heat from the cylindrical  
surface

7102.5 ft. lb. from 295 sq. in.  
of surface  
= 24.1 ft. lb. from each  
square inch.

The resistance on the face  
will be  $\frac{7}{100}$  ohm, and of  
each end  $\frac{3\frac{1}{2}}{100}$  ohm, with a  
radiating surface but  $\frac{1}{4}$  the  
the cyl. surface.

In South American dynamo

The length of each rod is

$$\frac{14.158 + 14.197}{2} = 14.178"$$

The no. of commutators is  
75 and the resistance of  
one side is

$$R = \frac{10.64 \times \frac{14.178}{12} \times 75}{\left(\frac{.192 + .183}{2}\right) \cdot 2} \quad \text{See page 27}$$

$$.0006007854$$

$$= .019747 \text{ ohms.}$$

and for both sides a total  
resistance of

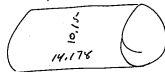
$$= .0098735 \text{ ohms.}$$

With  $x$  lamps (B. 16) with  
 $\frac{115}{4}$  ohms resist. the total  
outside resist. will be

$$\frac{115}{4x}$$

The B. 16 lamps require 151  
 55 volts - For the regular  
 A. 16 requires a certain  
 amount of energy expressed  
 by  $\frac{V^2}{R}$  and in the case  
 of the B. 16 by making  
 $E.M.F. = \frac{V}{2}$  and Resis.  
 $= \frac{R}{4}$  we have  
 $\frac{(\frac{V}{2})^2}{\frac{R}{4}} = \frac{V^2}{R} = \text{same}$   
 energy as before.

The armature is



Circum = 31.887

Radiating surface 452.129 in.

The outside resistance being  
 $\frac{115}{4x}$  on 55 volts, the drop

in armature <sup>face</sup> will be

$$\frac{55 \times .0098735 \times 4x}{115}$$

and the energy developed will be

$$\begin{aligned} & \frac{\left( \frac{55 \times .0098735 \times 4x}{115} \right)^2}{.0098735} \times 44.3 \\ & = \frac{1.601}{1662122} x^2 \end{aligned}$$

To obtain the same radiation  
per unit surface as before  
namely 24.1 ft. lb. per sq. in.  
we have

$$\begin{aligned} 24.1 \times 452.1 &= \frac{1.601}{1662122} x^2 \\ x^2 &= 6805 \\ x &= 83 \text{ lamps.} \end{aligned}$$

Therefore in respect to  
radiating surface the  
machine is ample

With 50 lamps of  $\frac{115}{4}$  ohms  
 each the fall is 55 volts on  
 $\frac{115}{200}$  ohms, suppose also 4  
 per cent. <sup>of this</sup> fall on connections  
 = 2.2 Volts, then assume the  
 resistance of the end discs  
 as equal to that of the  
 armature face, which will  
 be ample to make up for  
 increased resistance due  
 to connections, the total  
 armature resistance will  
 be  $.0098735 \times 2$   
 =  $.0197470$  ohms.

And the fall will be

$$\frac{55 \times .01975 \times 200}{115} = 1.9 \text{ ~~ohms~~ Volts.}$$

The total required E.M.F. will  
 be 59.1 and as contingency for  
 polarizing make it 60 volts.

By the curve which is taken as a basis of calculation the product of the current by the no. of turns should be 4700 and the value of 1 ft. of cutting wire at 1000 ft. per minute should equal .24 volts.

The face of magnet being 9.5" and 75 commutators single wound, the entire length of cutting conductor is 59.375 feet.

The diam. of core of armature is 9.7 and let 1200 revs. be assumed, which will give a cutting speed of 3047.35 feet per m.

$$59.375 \times 3.04735 \cancel{\times} \\ = 180.9364$$

*Volts required*

$$60 \div 180.9364$$

$$= .33161 \text{ volts per foot}$$

at 1000 ft. per min. are  
required.

To attain this the product  
of the current by the turns  
must be increased in  
like ratio

$$.24 : .33161 :: 4700 :$$

$$= 6494$$

In the case of the medium  
machine from which the  
experimental data were  
determined the product  
4700 was obtained on a  
one 36" long and to



obtain 6494 in like pro- 161  
hence we have

$$4700 : 6494 :: 36 :$$

$$= 50"$$

(omit)  
To which add 1" for washers.

$$= 51"$$

$$= 4' 3"$$

Instead of increasing by length  
let the increase be by diameter  
also, the cores were 6" diam.

We have therefore

$$\frac{6^2 \times 36 \times 6494}{4700} = 1792$$

and if 6.5" diam.

$$\frac{1792}{(6.5)^2} = 42.4$$

which increase to 43" for  
washers and make the  
available length  
= 42"

Instead of 55 volts on 163  
magnet assume but 75%  
= 41 Volts

If R is magnet resist.

$$\text{Current is } \frac{41}{R}$$

And T = no. turns

$$\frac{41 T}{R} = 6494$$

$$\frac{T}{R} = 158.4$$

Assume 40 ohms

Then

$$T = 6336$$

With No. 17 B. W. G. and double  
cotton  $\frac{15}{1000}$  insulation the  
total diam. = .058 + .015  
= .073

and turns in one layer  
=  $42" \div .073 = 575$

$$\begin{array}{r} 575 \\ 12 \\ \hline 6900 \end{array}$$

$$6336 \div 575$$

= 11 turns or

5.5 lb each core

See page 51

With six layers and  
taking account of the  
moulding we have

12650 feet and resid.  
of 40 turns.  
and weight

$$= .010183 \times 12650$$

= 128.8 lb. of copper.

The product of the turns  
by 41 and division by  
40 turns will give

6900 which is more  
than required, but the  
nearest by regular B.W. Gauge

When but few lamps are <sup>167</sup>  
on the full night volti  
may be considered as outside

With 100 lamp machine  
assume capacity for 125 lamps.

From page 153 the capacity  
of 50 light machine is in  
reality 83 lights.

and now this has to be in-  
creased to 125 lamps.

The cross-section of arma-  
ture wire should increase  
in like proportion

And its dimensions be  
in the ratio of the square  
roots. as  $\sqrt{83} : \sqrt{125}$

$$9.11 : 11.18$$

$$1 : 1.23$$

From page 27 the dimensions  
of the rod for the 50 light  
machine will be



and this should be increased  
in ratio of 1 to 1.23

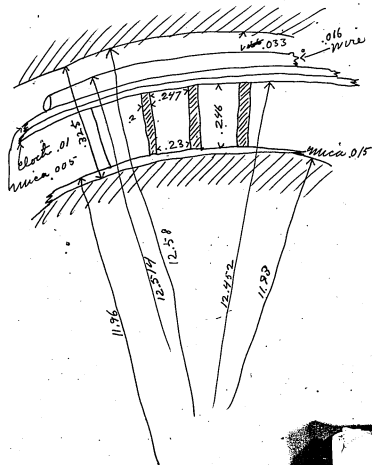
If the diam. 9.7 is increased  
in same ratio it becomes  
11.93. Let the insulation  
under the rods be .015"

Depth of rods  $.2 \times 1.23 = .246$ "

Cloth .01"

Mica .008"

Copper Drives  $\frac{28}{1000}$ "  
 Insulating paper  $\frac{11}{1000}$ "



The distance of field from  
anature core is

$$= .325$$

and at this distance 1 foot  
of cutting wire at 1000 ft. per  
minute = .22 Volt -

and product of <sup>should be</sup> current <sup>.2345 of wire</sup>  
by turns will be as deter-  
mined by diagram = 5948

$$\text{add to} = 6100$$

With 125 lamps of  $\frac{115}{4}$  ohms  
each, the total will be

$$\frac{115}{500} = .23 \text{ ohms.}$$



At the same cutting  
speed as dynamo D  
the revolutions per minute  
will be

$$\frac{9.7 \times 1200}{11.93} = 975 \text{ revs.}$$

Cutting speed

$$= 3045.2 \text{ feet}$$

Value of 1 foot at 1000 feet  
= .22 revs

Value at 3045.2 ft. per m.

$$3.0452 \times .22$$

$$= .669944$$

To give 60 revs it requires

$$\frac{60}{.669944} = 89.6 \text{ feet of}$$

cutting conductor.

With 75 commutators

this will give the required  
length of field

$$\frac{89.6 \times 12}{75} = 14\frac{1}{2}" \text{ approx.}$$

slightly excessive.

Cutting wire 90.6 feet-

$$\sqrt{\frac{.277}{23} \cdot 246} = .058671 \text{ ohms.}$$

$$\text{Resistance} = \frac{90.6 \times 8.357}{58671}$$

$$= .0129 \text{ ohms.}$$

Resis. total

$$= .00645 \text{ ohms.}$$

To the length of field (14.5")  
must be added 4.678 for  
extra length of rods to  
the discs = 19.178"

This increases resistance

in the ratio of

$$14.5 : 19.178 :: .00645$$

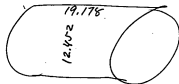
$$\text{Resis.} = .00853$$

From page 175 joint resis. of  
125 lamps in .23 ohm with a  
fall of 55 volts.

On the armature of .00852 ohm  
the fall will be

$$\frac{.00852}{.23} \times 55 = 2.04 \text{ Volts.}$$

$$\begin{aligned} \text{Total foot-lb. lost on armature} \\ \text{face} &= \frac{2.04 \times 44.3}{.00852} \\ &= 21613 \text{ ft. lb.} \end{aligned}$$



Radiating surface  
= 750 sq. in.

$$\frac{21613}{750} = 29 \text{ ft. lb.}$$

With 100 lamps this  
would be reduced  $\frac{1}{5}$   
or slightly more than  
23 ft. lb. per sq. in.  
which agrees with that  
for the common medium  
machine, See page 147.

Is only a product of  
 6100 of current by  
 turns is required by  
 using the same core as  
 with dynamos **D** and  
 the same number of  
 turns and layers

The field is increased in  
 length from  $9\frac{1}{4}$  to  $14\frac{1}{2}$   
 and the core should  
 be increased in like  
 proportion

$$\frac{6^2 \times 36 \times 14.5}{9.25} = 2032$$

Of 7" diam  
 length  $\frac{2032}{7} = 42$ " effective length  
 and 1" for fiber washers  
 = 43" total length

[illegible]
$$\begin{array}{r} 7. \\ \hline 7.512 \end{array}$$

Mean diameter 7.5/2

Circumference 23.6.

573 turns to a layer

Total 6876 turns, abundant  
in excess.

Total length = 135-22.8 feet

$$\text{Resistance} = \frac{10.64 \times 13522.8}{58^2}$$

$$= 42.8 \text{ ohms.}$$

If we suppose the E.M.F.

$$\begin{array}{r}
 13522.8 \\
 \times 0.010183 \\
 \hline
 137.7
 \end{array}$$

to be only the same the  
 Current will be one reber  
 and product by turns will  
 be 6876 which is  
 ample as only  
 6100 was required.

Weight =  $13522.8 \times 0.010183 = 137.7$  lbs.  
 of copper on magnets

Shaft.  $2\frac{1}{4}$ " steel.



With 200 light dynamos, the capacity should be at least 250 lights.

With 250 lights from page 169 the ratio of increase of rods should be

$$\sqrt{83} : \sqrt{250}$$

$$9.11 : 15.8$$

$$1 : 1.75$$

The rods for 50 lights are



and depth should increase to .35



Increase armature in  
same proportion

$$9.7 \times 1.75$$

$$= 16.975 \text{ diam.}$$

$$1200 \div 1.75$$

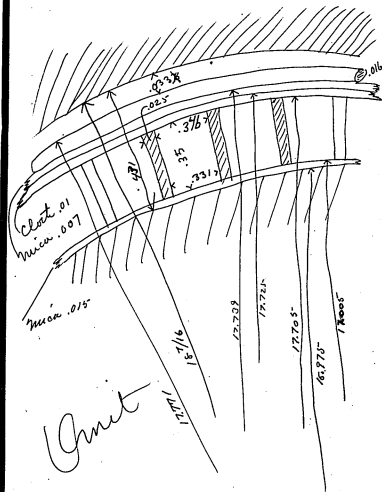
$$= 700 \text{ revolutions.}$$

At 700 revs. the cutting speed

$$= 700 \times 16.975 \times 3.1416$$

12

$$= 3111 \text{ ft. per min.}$$



With a space equal  
to 4.31 " the value of 1<sup>st</sup>  
cutting at a speed of  
1000 feet per m. is

$$= .223 \text{ Volts.}$$

and product of turns by current = 5900

Allow for a total fall of  
65 Volts.

The length of conductor

$$\text{is } \frac{65}{.223} = 94 \text{ feet}$$

Which will be made  
100 feet. or 1200 inches

$$\frac{1200}{75} = 16 \text{ inches for}$$

cutting length of armature

May 14, 1881.

With plates  $\frac{42}{1000}$  thick  
and paper insulation  
of  $\frac{15}{1000}$  with 75 plates  
the thickness will  
be 4.275" and the total  
length of rods will average  
 $16 + 4.5 = 20.5"$

The resistance of the armature  
face as made up of  
these rods is

$$\begin{aligned}
 &= \frac{75 \times \overset{20.5}{\cancel{1333}} \times 8.357}{12 \times 2 \times \left( \frac{346 + 831}{2} \right)^{35} \times 1000000} \\
 &= \frac{1284.88875}{2843400} \\
 &= .00452
 \end{aligned}$$

With 250 B-16 lamps 201  
the external resistance  
is  $\frac{115}{4 \times 250}$

$$= .115 \text{ ohms.}$$

With 55 volts fall on  
.115 ohms there will  
be within the armature  
a fall of  $\frac{.0045 \times 55}{.115}$  volts

$$= 2.152 \text{ Volts.}$$

The energy developed on  
the face of the armature  
in the form of heat  
is  $\frac{2.152^2 \times 493}{.0045} = 45580 \text{ ft.-lb.}$

per minute.

The radiating surface

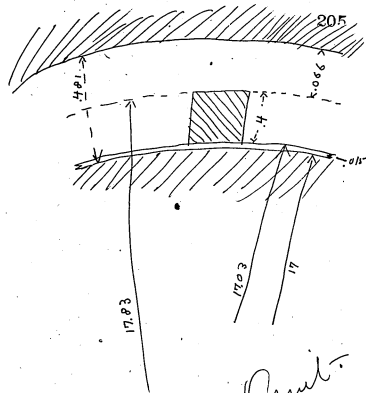
$$3.1416 \times 17.7 \times 20.5$$

$$= 1141 \text{ sq. in.}$$

which gives 40 ft. lb. per  
sq. in. which is too  
great.

---

If we make the ratio of  
change of rods in similar  
dynamos as 1.52 instead  
of 1.51.75 the depth becomes  
4 and assume diameter  
as 17" then the following  
diagram



Space .52

$$1^{\circ} \text{ at } 1000^{\circ} \text{ ft} = .2125$$

Space, 275

$$1^{\circ} \text{ at } 1000^{\circ} \text{ ft} = .24$$

$$\begin{array}{r} .52 \\ .275 \\ \hline .245 \end{array}$$

$$\begin{array}{r} .24 \\ .2125 \\ \hline .0275 \end{array}$$

$$\begin{array}{r} .481 \\ .275 \\ \hline .206 \end{array}$$

$$.245 : .206 :: .0275 : \\ = .0231$$

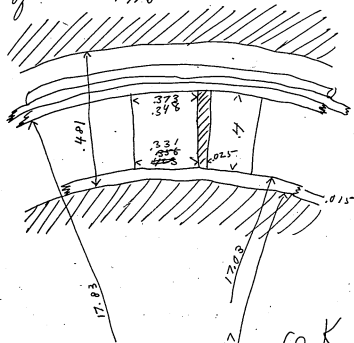
The value for a space  
of .481"

$$1^{\circ} \text{ at } 1000^{\circ} \text{ ft} = .2169$$

at 750 pps. per  
m. this requires 90 ft.  
cutting and 9.7 at 700  
ft. If we assume  
100 ft. w/ 1200 mches it  
will require 16" length



Signature and add 209  
10% excess we have a length  
of 17.6"



Plates  $\frac{42}{1000}$ " Thick  
Paper insulation  $\frac{15}{1000}$ "  
75 discs

O.K

The cross section is  
 $.1458 \text{ sq. in.}$   
 and total length of  
 rods  $22.2 \text{ inches}$

$$\text{Resist} = \frac{75 \times 22.2 \times 8.357}{12 \times 2 \times 145800}$$

$$= .004 \text{ ohms.}$$

The force of E. M. F. in far  
 of ammeter is  $1.91 \text{ Volts}$   
 and energy

$$\frac{1.91^2 \times 44.3}{.004} = 40402 \text{ ft.-lbs.}$$

Radiating surface

$$= 3,1416 \times 17 \times 22.2$$

$$= 1186 \text{ sq. in.}$$

Heat radiated from surface  
 of  $1 \text{ sq. in.} = 34 \text{ ft.-lbs.}$

With 250 lamps are  
 required (6 hp H.P.)

42 H.P.

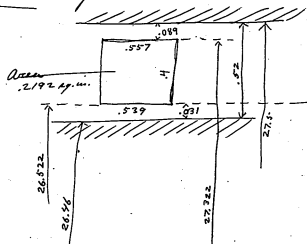
Suppose 250 H.P.  
or 1 H.P. per lamp.

$$\begin{array}{r} 700 \overline{) 250} \\ 2.06 \overline{) 3543} \\ \underline{\phantom{00}172} \end{array}$$

3" shaft of steel.  
Make it 3 1/4"

Clarke, July 15, 1881 215

C dynamo.



There are 279093 c. miles  
in the above conductor  
= 15.6 No. 10 B.W.G. wires.

$$R = \frac{10.33 \times 42.7 \times 73}{12 \times 279093}$$

$$= .00961 \text{ divide by } 2$$

$$= .0048 \text{ ohms is the}$$

resistance of entire rods  
there being 146 each 42.7 long  
and 73 commutator

Clark July 18, 1887.

The copper discs are of following dimensions



.065" thick

The area is  $546.35 - 135.3$   
 $= 411.05$

and multiply by thickness  
 $= 411.05 \times .065$   
 $= 26.71825$  inches.

Let us suppose as a most unfavorable condition that the entire amount is concentrated on the outside circumference and since the current passes from A to B two ways that the plates is folded in itself.

Half the circumference = 41.43"  
 and area of copper rod of this length is  $26.71825 \div 41.43$   
 $= .6449$  sq. in.

Clarke, July 18, 1881.

The circular mils =

$$.6449 \div .0000007854$$

$$= 821110$$

Resi. of 73 of these is

$$R = \frac{1033 \times 41.43 \times 73}{12 \times 821110}$$

$$R = .00311$$

$$\text{and } \div 2 = .001555 \text{ ohms.}$$

This must be added to the

resi. of 73 rods =

$$.00961 + .00311$$

$$= .01272 \text{ and if}$$

(as in the case) multiple  
and with another

$$R = .00636$$

This is the most-unfavorable  
showing possible for the  
discs of copper.

Clarke July 18, 1887.  
221

The diam. assume as 26.5"  
The circumference will be  
6.934 feet and travel at  
350 revs. per minute is  
2427 feet.

The strain or circumference  
for 150 H.P. is 2040 lbs.

Divide this between 176 bars  
= 11.2 lbs. per bar, or  
5.6 lbs. in each leg.

Each bar is 42.7" long  
and cross-section of 279093 cmil.

$$\text{Weight} = \frac{42.7}{12} \times 279093 \times .000003027$$

$$= 3 \text{ lbs.}$$

$$\text{Centrifugal force}$$

$$= \frac{26.5}{2 \times 12} \times \left( \frac{2427}{60} \right)^2$$

$$= 138 \text{ lbs.}$$

*[Faint, mostly illegible handwriting on page 222]*

Clarke, July 18, 1891  
223

If supported by a  
strap in the center  
the centrifigal force  
of half a bar will  
be 69 lbs.  
which puts a strain of  
34.5 lbs. on  
the lug.



Resistance coils for 255  
external circuit of dynamo C.

The work required will be  
150 H.P. = 4950000 ft. lbs.

$$\frac{I^2 \times 44.3}{R} = 4950000$$

$$R = .108 \text{ ohm.}$$

$$4950000 \div 772$$

$$= 6412 \text{ units of heat-}$$

If water goes in at 60° and  
out at 120° each pound of  
water takes 60 units per  
minute and for 6412 units  
it takes 107 lbs. of water  
per minute =  $107 \div 8.3$

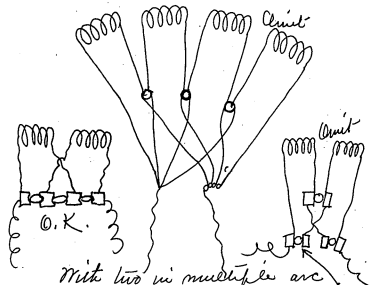
$$= 13 \text{ gallons.}$$

With 1300 feet of No. 15-B.W.G.  
=  $\frac{72}{1000}$ " in each barrel the  
resistance will be  
Weight .0157 lbs. per foot.

$$R = \frac{10.64 \times 1300}{3784}$$

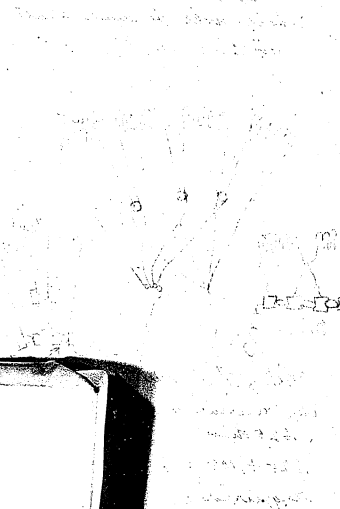
$$R = 2.67 \text{ ohms}$$

which will be made shorter  
to give 2.5 ohms.



With two in multiple arc  
the resistance will be  
.625 ohms

$.625 \div .108 = 6$  barrels are  
required.



A No. 10 B.W.G. wire has  
cross section of .0141 sq. in.  
and two of the armature rods



.4384 sq. in.

= 31 No. 10 wire.

18 wires will be sufficient  
and 6 barrels being required  
3 strands to each barrel.

Mar 18. 1881.

From page 275 the  
weight of the copper rods  
is 435 lbs. and radius  
13.46" = 1.122 feet

The value for centrifugal  
force is  $C' = \frac{4\pi^2}{g} \cdot w \cdot r \cdot n^2$ .

$$\begin{aligned}
 \log 4 &= 0.602060 \\
 (\log 13.46)^2 &= .994302 = (0.497151)^2 \\
 w &= 2.638489 \\
 r &= 0.049993 \\
 (n)^2 &= \frac{5.831338}{5.8716182} = (0.765669)^2 \\
 g = 32.167 &= \frac{1.507410}{4.308772}
 \end{aligned}$$

~~735800~~

20360.

The aggregate pull is 20360 lbs.  
and half is 10180 lbs.  
but this pressure is on the

circumference and should 263  
be changed to diameter

Ratios

$$3.1416 : 1 :: 20360 :$$

$$= 6480 \text{ lbs.}$$

$$\text{and } \frac{1}{2} = 3240 \text{ lbs. is}$$

the bursting strain on  
the bands.

Heat developed in  
dynamo C.

Length of rods 42.7"



Cross section

$$\begin{aligned} & \frac{(.557 + .539)}{2} \cdot 4 = .2192 \text{ sq. in.} \\ & = 219200 \text{ sq. mils.} \end{aligned}$$

Resis in 73 rods

$$= \frac{8.357 \times 73 \times 42.7}{12 \times 219200}$$

$$= .00994 \text{ ohms}$$

and true resistance of  
armature face for an equal  
number in multiple arc

$$= .00497 \text{ ohms}$$

With 1000 lamps (A. 16) the  
joint external resistance  
will be .115 ohms.

and with 110 Volts external  
the external horse-power

developed will be

$$\frac{110^2}{.115} \times 44.3 = 4661139 \text{ ft. lb.}$$

$$= 141 \text{ H.P.}$$

The fall of E.M.F. within the  
armature will be

$$\frac{.00497}{.115} \times 110 = 4.754 \text{ volts}$$

the loss of energy on face  
of armature will be

$$\frac{4.754^2 \times 44.3}{.00497} = 201442 \text{ ft. lb.}$$

$$= 6.1 \text{ H.P.}$$

No. sq. in. on radiating  
cyl. face =  $27.3 \times 3.1416 \times 42.7$   
= 3662 sq. in.

An amount of heat-  
radiated per sq. inch  
=  $\frac{201442}{3662} = 55 \text{ ft. lb.}$

May 3, 1881. <sup>271</sup>

Armington and Sims Fly Wheel  
Comparison of the energy with  
the energy of dynamo.

Since in the two cases  
the angular velocity is the  
same, in the formula  
for living force

$$L = \Sigma (m r^2) \theta^2$$

The angular velocity  $\theta$  may  
be omitted and the  
comparison is simply one  
of inertia moments  
 $\Sigma (m r^2)$

The fly wheel is of the  
following dimensions





The moment of inertia is 273

$$K = M \frac{r'^2 + r^2}{2}$$

$$r^2 = \frac{36^2}{18} \quad r'^2 = \frac{48^2}{24}$$

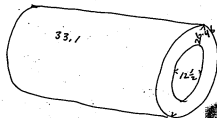
$$M = \frac{(1809.6 - 1017.9) \times 6 \times 450}{1728}$$

$$M = 1237 \text{ lb.}$$

$$K = 1237 \times \frac{450^2}{800}$$

$$K = \frac{4226600}{556650}$$

In the annature we have  
in thin iron plates and  
thick plates the equivalent  
of a wrought iron cylinder  
of the following dimensions



$$M = \frac{(551.5 - 122.72) \times 33.1 \times 485^{2.75}}{1728}$$

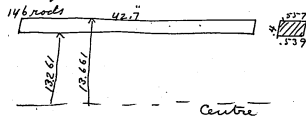
$$M = 3984 \text{ lbs.}$$

$$\bar{r}^2 = \frac{26.46^2}{13.23} \quad \bar{r}^2 = \frac{12.5^2}{6.25}$$

$$K = 3984 \times \frac{107.0475}{428.17}$$

$$K = \frac{1705909}{426477.25}$$

The copper rods form a cylinder of the following size for rods



$$M = \frac{557 + 539}{2} \times 4.4 \times 42.7 \times 146 \times 550$$

$$= 435 \text{ lbs.} \quad \bar{r}^2 = \frac{13.66^2}{13.26} \quad \bar{r}^2 = 13.26$$

$$K = 435 \times 181.2$$

$$K = 78822$$

There are 146 copper discs 277  
 $\frac{65}{1000}$ " thick and following  
 dimensions



$$M = \frac{(543.25 - 135.3) \times 0.65 \times 146 \times 5.50}{1728}$$

$$M = 1231 \text{ lbs.}$$

$$\bar{r}^2 = 13.1625 \quad \bar{r} = 6.56$$

$$K = 1231 \times 108$$

$$K = 132948$$

$$\text{The } \Sigma(K) = 426777 + 78822 + 132948$$

$$\Sigma(K) = 638247$$

$$\begin{array}{r}
 42.7 \text{ length of bars.} \\
 33.75 \text{ Useful length.} \\
 33.75 \overline{) 8.95} \quad 33.75 \overline{) 37.7\%} \\
 \underline{26.85} \quad \underline{67.5} \\
 6.10 \quad 26.5\% \\
 \underline{6.10} \quad \underline{63.5} \\
 0 \quad \text{Ratio of useless to} \\
 \quad \text{useful length of} \\
 \quad \text{bar.}
 \end{array}$$

Resis. of 42.7" = .0048 ohms.

Resis of 11 1/4" = .001265 ohms

Measured total resistance  
OFFICE OF THE  
 EDISON ELECTRIC LIGHT CO.  
 65, 5th AVE.  
 NEW YORK.  
 was .0085 ohms

Total Resis. with additional  
 length of bars of 33 1/3% on  
 face = .009765 ohms.

Gain in E.M.F. of 33 1/3%

Additional resis. of 14.9%

With .15 ohm external resis. the  
 E.M.F. was 85 volts

With internal resis. of .0085  
 this gives a drop in the machine

of 4.82 Volts.

2

If total is 85 + 4.82

= 89.82 volts

and we increase it 1/3

OFFICE OF THE  
 EDISON ELECTRIC LIGHT CO.  
 65, 5th AVE.  
 NEW YORK.  
 Total E.M.F. = 119.76 volts

With external resistance  
 of .15 ohms and internal  
 resistance of .009765 ohms  
 the drop in armature  
 will be 7.7963 ohms.

External E.M.F.

= 111.9637 ohms.

The new length of bars  
 is 53.95"

Available length is 45"

Ratio of useless to useful  
 19.9%.

3

With 4 calorimeters the  
resis. external is .15  
and with five calorimeters  
will be .12 ohms.

With .12 ohms external resis.,  
the E.M.F. was 85 volts.

With internal resis. of .0085  
this gives a drop in the  
machine of 6.02

Of total is  $85 + 6.02$

$= 91.02$  ohms.

and increase it -  $1/3$

True E.M.F.

$= 125.01926$

OFFICE OF THE  
EDISON ELECTRIC LIGHT CO.,  
65, 5th AVE.,  
—NEW YORK.—

4

With external resistance  
of .12 ohms and internal  
resistance of .009765 ohms  
the drop in armature  
will be  $9.876^{14}$

External E.M.F.  
 $112.484^{22}$

OFFICE OF THE  
EDISON ELECTRIC LIGHT CO.,  
65, 5th AVE.,  
—NEW YORK.—

The resist. of armature  
was measured at  $- 82^{\circ}\text{F.}$   
to be .0085

The end discs of copper  
will not be considered as  
rising in temperature.

The resist. of bars at  
 $60^{\circ}\text{F.}$  is calculated to be  
.0048 ohms.

At  $82^{\circ}\text{F.}$  it will be  $.0048 \times 1.0472$   
 $= .005028$  ohms.

The measured resist., being .0085  
the resist. due to copper discs and  
connections is .003473 ohms.

If the temp. be increased  
in the rods to  $130^{\circ}$  the resist.  
will be  $.0048 \times \frac{.065 \times 70}{30} + 1$

$= .00553$  ohms  
OFFICE OF THE  
EDISON ELECTRIC LIGHT CO.,  
65, 5th AVE.,  
—NEW YORK.—

Total internal resist. will be 6  
 $= .009$  ohms.

With addition of  $\frac{1}{2}$  to  
the available length of bars  
the resist. of bars at  $60^{\circ}\text{F.}$   
is  $.0048 + .0048$   
 $\frac{2}{3}$

$= .006065$  ohms.

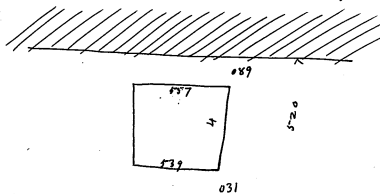
The resist. at  $130^{\circ}$   
OFFICE OF THE  
EDISON ELECTRIC LIGHT CO.,  
65, 5th AVE.,  
—NEW YORK.—  
 $.006065 \times 1.15-17$   
 $= .006985$  ohms.

Total resistance  
 $.006985 + .003473$   
 $= .01046$  ohms.

With total E.M.F.  
 $= 121.36$

The internal drop of E.M.F.  
 $= 9.76$

Total External  
 $= 111.6$



Cross-Section of bars  
of dynamos C as at-  
present.

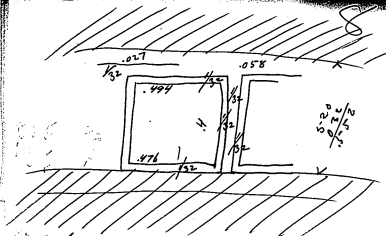
OFFICE OF THE  
EDISON ELECTRIC LIGHT CO.,  
65, 5th AVE.,  
NEW YORK

Cross-section = .2192 sq. in.

If  $\frac{1}{32}$ " off each side  
= .0625 the

Cross-section = .1942

Which shows an increase of  
res. in armature face of  
13%.



From page 6 the resistance  
of the bars at 60°F is  
.006065 and this will be  
increased by 13%.

$$= .00685$$

And at 130°F =

OFFICE OF THE  
EDISON ELECTRIC LIGHT CO.,  
65, 5th AVE.,  
NEW YORK

$$.00685 \times 1.1517$$

$$= .00789 \text{ ohms.}$$

Notes =

$$.00789 + .003473$$

$$= .011363 \text{ ohms.}$$

With total E.M.F. = 121.36

Internal drop 60.5 volts

External 110.86

A hand-drawn sketch of a rectangular structure, possibly a foundation or a small building. The structure is defined by a double-line border. Inside the rectangle, the dimensions are labeled: the top side is 494, the right side is 463, and the bottom side is 476. To the left of the rectangle, there are handwritten notes: "6/18", "4/18", and "\$500000". Above the rectangle, there are handwritten notes: "1/6", "1/32", and "1/32". Below the rectangle, there are handwritten notes: "1/32" and "1/32 more". The entire sketch is enclosed in a larger rectangular frame with a diagonal hatched pattern on the top and bottom edges. A large number "9" is written in the top right corner.

If  $1/16$  is added to the scrap the cross section is .2245 sq. in. which is a decrease of resist. of  $2\frac{1}{2}\%$ .

$$\begin{array}{r} .619 \\ .0325 \\ \hline .65025 \\ .052 \\ \hline 1.13 \end{array}$$

OFFICE OF THE  
EDISON ELECTRIC LIGHT CO.,  
65, 5th AVE.,  
—NEW YORK.—



15 runs for 4 barrels  
 4  
 .50 runs for 1 barrel.  
 130 rolls total

$$\begin{array}{r} .009765 \\ 130 \\ \hline 609765 \overline{) 1.2694500} \left( \begin{array}{l} 2.1 \text{ runs} \\ 1 \text{ barrel} \end{array} \right. \\ \underline{1219530} \\ 499200 \end{array}$$

$$\begin{array}{r} .309765 \\ \hline 309765 \overline{) 1.2694500} \left( \begin{array}{l} 4.1 \text{ runs} \\ 2 \text{ barrels} \end{array} \right. \\ \underline{1239060} \\ 303900 \end{array}$$

$$\begin{array}{r} .209765 \\ \hline 209765 \overline{) 1.2694500} \left( \begin{array}{l} 6.05 \text{ runs} \\ 3 \text{ barrels} \end{array} \right. \\ \underline{1258590} \\ 1086000 \end{array}$$

$$\begin{array}{r} .159765 \\ \hline 159765 \overline{) 1.2694500} \left( \begin{array}{l} 7.9 \text{ runs} \\ 4 \text{ barrels} \end{array} \right. \\ \underline{1118355} \\ 1510950 \end{array}$$

$$\begin{array}{r} .129765 \\ \hline 129765 \overline{) 1.2694500} \left( \begin{array}{l} 9.8 \text{ runs} \\ 5 \text{ barrels} \end{array} \right. \\ \underline{1167885} \\ 1015650 \end{array}$$

OFFICE OF THE  
 EDISON ELECTRIC LIGHT CO.  
 65, 5th AVE.  
 NEW YORK.

$$\begin{array}{r} 130 \\ 2.1 \\ \hline 127.9 \text{ runs } 1 \text{ barrel} \end{array}$$

$$\begin{array}{r} 130 \\ 4.1 \\ \hline 125.9 \text{ runs } 2 \text{ barrels} \end{array}$$

$$\begin{array}{r} 130 \\ 6.05 \\ \hline 123.95 \text{ runs } 3 \text{ barrels} \end{array}$$

$$\begin{array}{r} 130 \\ 7.9 \\ \hline 122.1 \text{ runs } 4 \text{ barrels} \end{array}$$

$$\begin{array}{r} 130 \\ 9.8 \\ \hline 120.2 \text{ runs } 5 \text{ barrels} \end{array}$$

OFFICE OF THE  
 EDISON ELECTRIC LIGHT CO.  
 65, 5th AVE.  
 NEW YORK.

127.9  
 125.9  
 123.95  
 122.1  
 120.2

130  
 119  
 108  
 95  
 85

3.9  
 7.4  
 9.4  
 7.0

98.4%  
 11  
 11  
 13  
 10

127.9  
 125.9  
 123.95  
 122.1  
 120.2

[ITEM FOUND IN BOOK]

$$\begin{array}{r} 130 \overline{) 127.9} \quad 984 \\ \underline{1170} \\ 1090 \\ \underline{1040} \\ 500 \end{array}$$

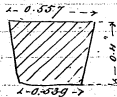
$$\begin{array}{r} 125.9 \overline{) 119.00} \quad 94.5 \\ \underline{11331} \\ 5690 \\ \underline{5036} \\ 6540 \end{array}$$

$$\begin{array}{r} 123.95 \overline{) 108.000} \quad 87.1 \\ \underline{99160} \\ 88400 \\ \underline{86765} \\ 16350 \end{array}$$

$$\begin{array}{r} 122.1 \overline{) 95.000} \quad 77.7 \\ \underline{85428} \\ 9570 \end{array}$$

$$\begin{array}{r} 120.2 \overline{) 85.000} \quad 70.7 \\ \underline{84144} \\ 8560 \end{array}$$

OFFICE OF THE  
EDISON ELECTRIC CO.  
65, 5th AV.  
NEW YORK.



43 rods 12.660' long.  
72 rods 12.745' long.  
1 rod 36.54' long.

*Armature Rods of Dynamo C.*

**Menlo Park Notebook #215 [N-81-02-04]**

This notebook covers the period February 1881. The entries are by Francis Jehl and consist of calculations relating to resistances of experimental lamps. The label on the front cover is marked "Experimental Lamps 2," "1881," and "Francis Jehl." There is an index on the inside front cover. The book contains 280 numbered pages.

# Anderson

- Order 32-67 to 85  
 " 35-212 to 221  
 " 37-46, 7, 10, 11, 15, 16, 21, 189, 190.  
 " 39-58 to 66  
 " 43-142, 145, 146, 150  
 " 44-8,  
 " 45-12, 18, 22  
 " 47-122, 123, 144, 143, 144  
 " 48-117  
 " 123-99, 102  
 " 124-103, 116  
 " 130-1, 2, 161  
 " 129-140  
 " 138-169  
 " 139-86, 87, 88, 89, 90.  
 " 140-37, 39, 40 to 57, 159, 160.  
 " 141-25, 26, 27 to 36, 38  
 " 145-157, 158  
 " 146-91 to 97, 187, 188.  
 " 150-224, 225, 226.  
 " 155-17  
 " 156-3, 5, 9, 13, 14, 19, 20, 23, 24, 147 to 149, 151-156.  
 " 157-170 to 186  
 " 158-162 to 168.  
 " 192-191 to 211.  
 " 202-237 to 280  
 " 205-222, 223, 227 to 236.

Feb. 4, 1881.  
 Order 130-R 190  
 91 V-18

Volts 108.67

48 C

Res.  $\frac{18840}{1100} R$

200/19940/99

1800

1940

1800

140

119

100

19 Chines inserted.

130

100

109/13000/119

109

210

109

1810

981

29

Feb. 4, 1881.  
Order 130 - R 230  
100 U - 12

Uells 12285 ✓

Res  $\frac{18840}{6000} R$   
200 /  $\frac{24840}{200} / 124$   
 $\frac{484}{400}$   
 $\frac{840}{800}$   
 $\frac{40}{40}$

$\frac{130}{124}$

$\frac{131}{124}$

7 Chms inserted.

$\frac{520}{260}$   
 $\frac{130}{123}$   
123 / 16120 / 131  
 $\frac{382}{369}$   
 $\frac{130}{123}$   
7

480

Feb. 4, 1881  
Order 156 - R 385  
No. 1

Uells 11812 ✓

Res  $\frac{18840}{2400} R$   
200 /  $\frac{24840}{200} / 106$   
 $\frac{1240}{1200}$   
 $\frac{40}{40}$

$\frac{138}{106}$

$\frac{117}{106}$

11 Chms inserted.

$\frac{780}{130}$   
118 / 13780 / 116  
 $\frac{198}{118}$   
 $\frac{800}{708}$   
92

480

Feb. 4 1881.  
Order 37-R225  
No. 5

Vols. 118.8

48C

$$\begin{array}{r} \text{Res } 1840 \\ 2300 \end{array} | R \\ 200/21140 \\ \hline 106$$

$$\begin{array}{r} 130 \\ 106 \\ \hline 780 \end{array} \quad \begin{array}{r} 116 \\ 106 \\ \hline 10 \end{array}$$

Chms inserted.

$$\begin{array}{r} 130 \\ 119/13780/115 \\ \hline 119 \\ 188 \\ \hline 119 \\ 690 \\ \hline 595 \\ \hline 95 \end{array}$$

Feb. 4 1881.  
Order 156-R380  
No. 2

118112 V

48C

$$\begin{array}{r} 1840 \\ 1500 \end{array} | R \\ 200/20340/101 R \\ \hline 200$$

$$\begin{array}{r} 340 \\ 200 \\ \hline 140 \end{array} \quad \begin{array}{r} 112 \\ 101 \\ \hline 11 \end{array}$$

Chms inserted.

$$\begin{array}{r} 130 \\ 102 \\ \hline 260 \\ 130 \\ 119/13260/111 \\ \hline 119 \\ 136 \\ \hline 119 \\ 170 \\ \hline 119 \\ \hline 51 \end{array}$$

Feb. 4, 1881.  
Order 37-R200  
No. 6

116.775

48C

$$\begin{array}{r} 18840 \\ 1400 R \\ \hline 200 \overline{) 20240} 101 \\ 200 \\ \hline 240 \\ 200 \\ \hline 40 \end{array}$$

112  
101  
11 Ohms inserted.

$$\begin{array}{r} 130 \\ 101 \\ \hline 130 \\ 130 \\ \hline 117 \overline{) 13130} 112 \\ 117 \\ \hline 143 \\ 117 \\ \hline 260 \\ 234 \\ \hline 26 \end{array}$$

Feb. 4, 1881.  
Order 37-R230  
No. 4

118.125

48C

$$\begin{array}{r} 18840 \\ 3400 R \\ \hline 200 \overline{) 22240} 111 \\ 200 \\ \hline 224 \\ 200 \\ \hline 240 \\ 200 \\ \hline 40 \end{array}$$

122  
111  
11 Ohms inserted.

$$\begin{array}{r} 130 \\ 111 \\ \hline 130 \\ 130 \\ \hline 130 \\ 130 \\ \hline 118 \overline{) 14430} 122 \\ 118 \\ \hline 263 \\ 236 \\ \hline 270 \\ 236 \\ \hline 34 \end{array}$$

Feb. 4, 1881.  
Order 44-R280.

Uels 114.75

$$\begin{array}{r} \text{Res. } 18840 \\ 3200 \text{ R} \\ 200 \overline{) 22140 / 110} \\ \underline{200} \\ 214 \\ \underline{200} \\ 140 \end{array}$$

$$\begin{array}{r} 130 \\ 111 \\ \hline 130 \\ 130 \\ \hline 130 \end{array} \quad \begin{array}{r} 126 \\ 111 \\ \hline 15 \text{ Chms inserted.} \end{array}$$

$$\begin{array}{r} 130 \\ 130 \\ \hline 115 \overline{) 14430 / 125} \\ \underline{115} \\ 293 \\ \underline{230} \\ 630 \\ \underline{575} \\ 55 \end{array}$$

48C

Feb. 4, 1881.  
Order 156-R390  
No. 3

Uels 116.10

$$\begin{array}{r} \text{Res. } 18840 \\ 1200 \text{ R} \\ 200 \overline{) 20040 / 100} \\ \underline{200} \\ 120 \end{array}$$

$$\begin{array}{r} 130 \\ 100 \\ \hline 116 \overline{) 13000 / 112} \\ \underline{116} \\ 140 \\ \underline{116} \\ 240 \\ \underline{232} \\ 8 \end{array} \quad \begin{array}{r} 112 \\ 100 \\ \hline 12 \text{ Chms inserted.} \end{array}$$

48C



Feb. 4, 1881.  
Order 37-R200  
No. 7

Volts N. G. vacuum.

Res

Feb. 4, 1881.  
Order 37-R195  
No. 3

Volts. ~~100~~ 113.84

Res. 18840 48C  
800 R

200/19640/98  
1800  
1640  
1600  
40

130  
98

1040

1170

111/12740/114  
111

164

111

530

444

86

115  
98

17 Chms inserted.

Feb. 4, 1881.  
Order 45-P233  
92 1/2 U-H

109.35 v

$$\begin{array}{r} 18840 \\ 1400 \text{ R} \\ \hline 200 \overline{) 20240} / 101 \\ \underline{200} \\ 240 \\ \underline{200} \\ 40 \end{array}$$

$$\begin{array}{r} 130 \\ 101 \\ \hline 130 \end{array}$$

20 Chms inserted.

$$\begin{array}{r} 130 \\ 109 \overline{) 13130} / 120 \\ \underline{109} \\ 223 \\ \underline{218} \\ 50 \end{array}$$

48c

Feb. 4, 1881.  
Order 156-P365  
No. 9

116.10 v

$$\begin{array}{r} 18840 \text{ R} \\ 150.0 \\ \hline 200 \overline{) 20340} / 101 \\ \underline{200} \\ 340 \\ \underline{200} \\ 140 \end{array}$$

$$\begin{array}{r} 114 \\ 102 \\ \hline 12 \end{array}$$

Chms inserted.

$$\begin{array}{r} 130 \\ 102 \\ \hline 260 \\ 116 \overline{) 13260} / 114 \\ \underline{116} \\ 166 \\ \underline{116} \\ 500 \\ \underline{464} \\ 36 \end{array}$$

48c

Feb. 4, 1881.  
Order 156-R375  
No. 4

$$\begin{array}{r}
 111340 \\
 18840 \\
 \hline
 15000 \text{ R} \\
 200 \overline{) 20340} / 101 \\
 \underline{200} \\
 340 \\
 \underline{200} \\
 140
 \end{array}$$

48e

18 Chms inserted.

Feb. 4, 1881.  
Order 37-R205  
No. 8

$$\begin{array}{r}
 111340 \\
 18840 \\
 \hline
 15000 \text{ R} \\
 200 \overline{) 20340} / 101 \\
 \underline{200} \\
 340 \\
 \underline{200} \\
 140
 \end{array}$$

48e

120  
102  
18 Chms inserted.

$$\begin{array}{r}
 130 \\
 \underline{102} \\
 260 \\
 130 \\
 \hline
 111 \overline{) 13260} / 119 \\
 \underline{111} \\
 216 \\
 \underline{111} \\
 1050 \\
 \underline{999} \\
 51
 \end{array}$$

Feb. 4, 1881.  
Order 37-R 205  
No. 2

111.34V

48C

$$\begin{array}{r} 18840 \\ 1700R \\ 200 \overline{) 20540} / 102 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 540 \\ 400 \\ \underline{140} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{103} \end{array}$$

$$\begin{array}{r} 390 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 111 \overline{) 13390} / 120 \\ \underline{111} \\ 229 \\ \underline{222} \\ 90 \end{array}$$

$$\begin{array}{r} 121 \\ \underline{103} \end{array}$$

18 Chms inserted.

Feb. 4, 1881.  
Order 155-  
11

57.335

48C

$$\begin{array}{r} 6279 \\ 1300R \\ 200 \overline{) 7579} / 37 \\ \underline{600} \end{array}$$

$$\begin{array}{r} 1579 \\ \underline{1400} \end{array}$$

$$\begin{array}{r} 179 \end{array}$$

$$\begin{array}{r} 86 \\ \underline{38} \end{array}$$

48 Chms inserted.

$$\begin{array}{r} 130 \\ \underline{38} \end{array}$$

$$\begin{array}{r} 1040 \\ \underline{390} \end{array}$$

$$\begin{array}{r} 57 \overline{) 4040} / 86 \\ \underline{456} \end{array}$$

$$\begin{array}{r} 380 \\ \underline{342} \end{array}$$

$$\begin{array}{r} 38 \end{array}$$

Feb. 4, 1881.  
Order 45-P262  
113 1/2 V-22

130 V

48 e

$$\begin{array}{r} 25127 \\ 30000R \\ \hline 200 \overline{) 28127} \phantom{00} / 140 \\ \underline{200} \phantom{00} \\ 812 \\ \underline{800} \\ 127 \end{array}$$

$$\begin{array}{r} 130 \\ 140 \\ \hline 5200 \\ 130 \\ \hline 130 \overline{) 18200} \phantom{00} / 140 \\ \underline{130} \phantom{00} \\ 520 \phantom{00} 140 \\ \underline{520} \phantom{00} 0 \\ 520 \phantom{00} 0 \\ \hline 0 \end{array}$$

Feb. 4, 1881.  
Order 156-P410  
No. 8

111.34 V

$$\begin{array}{r} 18840R \\ 22000R \\ \hline 200 \overline{) 21040} \phantom{00} / 105 \\ \underline{200} \phantom{00} \\ 1040 \\ \underline{1000} \\ 40 \end{array}$$

$$\begin{array}{r} 123 \\ 105 \\ \hline 18 \text{ Chans inserted.} \end{array}$$

$$\begin{array}{r} 130 \\ 105 \\ \hline 650 \\ 130 \\ \hline 111 \overline{) 13650} \phantom{00} / 122 \\ \underline{111} \phantom{00} \\ 255 \\ \underline{222} \\ 330 \\ \underline{222} \\ 108 \end{array}$$

Feb. 4, 1881.  
Order 156-R 350  
No. 5

108.5

$$\begin{array}{r} 18840 \\ \underline{800} \\ 200 \overline{) 19340} \end{array} \begin{array}{l} R \\ 96 \\ \underline{1800} \\ 1340 \\ \underline{1200} \\ 140 \end{array}$$

115  
99  
18 Chms inserted

$$\begin{array}{r} 130 \\ \underline{96} \\ 780 \\ \underline{1170} \\ 109 \overline{) 12480} \end{array} \begin{array}{l} 114 \\ \underline{109} \\ 158 \\ \underline{109} \\ 490 \\ \underline{436} \\ 54 \end{array}$$

Feb. 4, 1881.  
Order 37-R 230  
No. 1

114.75V

$$\begin{array}{r} 18840 \\ \underline{3200} \\ 200 \overline{) 22040} \end{array} \begin{array}{l} R \\ 110 \\ \underline{200} \\ 204 \\ \underline{200} \\ 40 \end{array}$$

14 Chms inserted

$$\begin{array}{r} 130 \\ \underline{110} \\ 1300 \\ \underline{130} \\ 115 \overline{) 14300} \end{array} \begin{array}{l} 124 \\ \underline{110} \\ 14 \\ \underline{280} \\ 230 \\ \underline{500} \\ 460 \\ \underline{40} \end{array}$$

22

Feb. 4 1881.  
Order 45-R 278  
No. 1

Feb. 4 1881.  
Order 156-R 365  
No. 7

23

114.75V

18840R

3200

200/22040/110

200

204

200

40

14 ohms in air

124  
110

14

115:130:110

130

110

1300

130

115) 14300 (124

280

220

500

Feb. 4, 1881  
Order 156-R 340  
No. 6

111.245

18840R

200/19640/98. 17 olms insert

1800  
1670  
1600  
40

111:130 :: 98: 981X

130  
98  
1040  
1170

115  
98  
17

111/12740 (114

164  
111

AXR  
E - R = 17

Feb. 4, 1881.  
Order 141-R 295  
10



26

Feb. 4, 1881.  
Order 141-R 295  
12

30 @ air 130v  
high R.

27

Feb. 4, 1881.  
Order 141-R 240  
14

124.835

18840 R  
3600 R  
200/22440/112  
200  
244  
200  
440  
400 117  
40 112  
5 Chms inserted

130  
112  
260  
130  
130  
125/14560/116  
125  
206  
125  
810  
750  
60

28

Feb. 4, 1881.  
Order 141-R 245  
26 (A)

124.835

$$\begin{array}{r} 18840 \\ 3600 \\ \hline 200 \overline{) 22440} \\ 112 \end{array} \quad \text{R} \quad -5 \text{ Chms inserted}$$

29

Feb. 4, 1881.  
Order 141-R 240  
15

124.835

$$\begin{array}{r} 18840 \\ 3600 \\ \hline 200 \overline{) 22440} \\ 200 \\ \hline 2440 \\ 200 \\ \hline 440 \end{array} \quad \text{R} \quad -5 \text{ Chms inserted}$$

30

Feb. 4, 1881.  
Order 141 - R 285  
3

1305

25127 R

31

Feb. 4, 1881.  
Order 141 - R 285  
4

1305

25127  
600 R  
200  $\overline{) 25727 / 123}$   
200  
372  
400  
727

Feb. 4, 1881.  
Order 141-R 295  
28

130 V

25127 R

Feb. 4, 1881.  
Order 141-R 240 (1)  
26 (B)

121.50 V

18840  
3600 R

$$\begin{array}{r} 200 \overline{) 22440} \quad / 112 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 244 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 440 \\ \underline{400} \\ 40 \end{array}$$

$$\begin{array}{r} 119 \\ \underline{112} \end{array}$$

7 Chms inertes.

$$\begin{array}{r} 130 \\ \underline{112} \end{array}$$

$$\begin{array}{r} 26.0 \end{array}$$

$$\begin{array}{r} 130 \end{array}$$

$$\begin{array}{r} 130 \end{array}$$

$$\begin{array}{r} 122 \overline{) 14560} \quad / 119 \\ \underline{122} \end{array}$$

$$\begin{array}{r} 236 \end{array}$$

$$\begin{array}{r} 122 \end{array}$$

$$\begin{array}{r} 1140 \end{array}$$

$$\begin{array}{r} 1098 \end{array}$$

$$\begin{array}{r} 44 \end{array}$$

Feb. 4, 1881.  
Order 141-R 300  
14

130 ✓

$$\begin{array}{r} 18840 \\ 9600 R \\ 200 \overline{) 28440} \\ \underline{142} \end{array}$$

Feb. 4, 1881.  
Order 141-R 280  
18

126.90 ✓

$$\begin{array}{r} 18840 \\ 4600 R \\ 200 \overline{) 23440} / 117 \\ \underline{200} \\ 344 \\ \underline{200} \\ 1440 \\ \underline{1400} \\ 40 \end{array} \quad \begin{array}{r} 120 \\ \underline{117} \\ 30 \text{ lines inserted.} \end{array}$$
  

$$\begin{array}{r} 130 \\ \underline{117} \\ 910 \\ 130 \\ \underline{130} \\ 127 \overline{) 15210} / 119 \\ \underline{127} \\ 251 \\ \underline{127} \\ 1240 \\ \underline{1143} \\ 97 \end{array}$$

Feb. 4, 1881.  
Order 141-R 245  
7

126.905

18840  
4600

R = 3 Chms inserted.

200 | 23445

117

Feb. 4, 1881.  
Order 140-  
37

1305

18840

6100

R

200 | 24940

125

Feb. 4, 1881.  
Order 141-R 380  
11

120.5

$$\begin{array}{r} 18840 \\ 8500 \text{ R} \\ \hline 200 \overline{) 27340} \phantom{0} / 136 \\ \underline{200} \\ 734 \\ \underline{600} \\ 1340 \\ \underline{1200} \\ 140 \end{array}$$

$$\begin{array}{r} 130 \\ 137 \\ \hline 910 \\ 390 \\ \hline 130 \\ 130 \overline{) 17810} \phantom{0} / 137 \\ \underline{130} \\ 481 \\ \underline{390} \\ 910 \\ \underline{910} \end{array}$$

Feb. 4, 1881.  
Order 140-R  
No. 2

124.835

$$\begin{array}{r} 18840 \\ 4500 \text{ R} \\ \hline 200 \overline{) 23640} \phantom{0} / 118 \\ \underline{200} \\ 364 \\ \underline{200} \\ 1640 \\ \underline{1600} \\ 40 \end{array} \quad \begin{array}{r} 123 \\ 118 \\ \hline 5 \text{ Chms inserted} \end{array}$$

$$\begin{array}{r} 130 \\ 118 \\ \hline 1040 \\ 130 \\ \hline 130 \\ 125 \overline{) 15340} \phantom{0} / 122 \\ \underline{125} \\ 284 \\ \underline{250} \\ 340 \\ \underline{250} \\ 90 \end{array}$$

Feb. 4, 1881.  
Order 1140 - R 320  
21

130 ✓

$$\begin{array}{r} 18840 \\ 6600 \\ \hline 25440 \\ 127 \end{array} R$$

Feb. 4, 1881.  
Order 1140  
No. 7

126.22 ✓

$$\begin{array}{r} 18840 \\ 5300 \\ \hline 200 \overline{) 24140} / 120 \\ \underline{200} \\ 414. \\ \underline{400} \\ 140 \quad 125 \\ 130 \quad 120 \\ \underline{120} \\ 10 \\ 130 \\ \underline{130} \\ 260 \\ 130 \\ \hline 126 \overline{) 15730} / 125 \\ \underline{126} \\ 313 \\ \underline{252} \\ 610 \\ \underline{610} \end{array}$$

5 Chms inserted.



Feb. 4, 1881.  
Order 140 - R 360  
23

130 ✓ 32C

25127  
4600 R  
200 | 29727  
148

n.s.

Feb. 4, 1881.  
Order 140 - R 350  
10

130 ✓

25127  
3000 R  
200 | 28127  
148

Feb. 4, 1881.  
Order 140  
30

126.90 ✓

25127R  
303R

200/25427/127

200

542

400

1427

1400

27

130

127

910.

260

130

127/16510/130

127

381

381

0

130

127

3

Chms inserted

Feb. 4, 1881.  
Order 40  
No. 31

123.52 ✓

18840  
3500R

200/22640/113

200

264

200

640

600

40

130

113

390

130

130

124/14690/118

124

229

124

1050

982

58

119

113

6 Chms inserted.

Feb. 4, 1881.  
Order 140-R  
No. 32

126.225

$$\begin{array}{r} 18540 \\ 4800 \text{ R} \\ \hline 200 \overline{) 23640} \end{array}$$

$$\begin{array}{r} 200 \\ \hline 364 \\ \hline 200 \\ \hline 1640 \\ \hline 1600 \\ \hline 40 \end{array}$$

$$\begin{array}{r} 130 \\ \hline 118 \end{array}$$

$$\begin{array}{r} 1040 \end{array}$$

$$\begin{array}{r} 130 \end{array}$$

$$\begin{array}{r} 130 \end{array}$$

$$126 \overline{) 15340} \begin{array}{l} 121 \\ 126 \end{array}$$

$$\begin{array}{r} 274 \end{array}$$

$$\begin{array}{r} 252 \end{array}$$

$$\begin{array}{r} 220 \end{array}$$

$$\begin{array}{r} 126 \end{array}$$

$$\begin{array}{r} 94 \end{array}$$

$$\begin{array}{r} 118 \\ \hline 122 \end{array}$$

6 Chms inserted.

Feb. 4, 1881.  
Order 140-R  
No. 33

124.205

$$\begin{array}{r} 18540 \\ 4100 \text{ R} \\ \hline 200 \overline{) 22940} \end{array}$$

$$\begin{array}{r} 200 \\ \hline 294 \end{array}$$

$$\begin{array}{r} 200 \end{array}$$

$$\begin{array}{r} 940 \end{array}$$

$$\begin{array}{r} 800 \end{array}$$

$$\begin{array}{r} 140 \end{array}$$

$$\begin{array}{r} 121 \end{array}$$

$$\begin{array}{r} 115 \end{array}$$

6 Chms inserted.

$$\begin{array}{r} 130 \end{array}$$

$$\begin{array}{r} 115 \end{array}$$

$$\begin{array}{r} 650 \end{array}$$

$$\begin{array}{r} 130 \end{array}$$

$$\begin{array}{r} 138 \end{array}$$

$$124 \overline{) 14950} \begin{array}{l} 120 \\ 124 \end{array}$$

$$\begin{array}{r} 255 \end{array}$$

$$\begin{array}{r} 248 \end{array}$$

$$\begin{array}{r} 70 \end{array}$$

Feb. 4, 1881.  
Order 140  
No. 34

124.835

18540  
4800 R

200/23640/118  
200

364

200

1640

1600

40

130

118

1040

130

130

125/15340/122  
125

284

250

340

250

90

123

118

5 Chms inserted.

Feb. 4, 1881.  
Order 140  
No. 35

124.835

18540  
4900 R

200/23740/118  
200

374

200

1740

1600

140

130

119

1170

130

130

125/15470/123  
125

297

250

470

375

95

124

118

6 Chms inserted.

Feb. 4, 1881.  
Order 140-  
No. 36

119.41V

~~15840~~  
4700 | R

200/23540/117  
200

354  
200

1540  
1400

140

129  
118

11 Chms inserted

130  
118

1040

130

130

119/15340/128

119

344

238

1060

952

112

Feb. 4, 1881.  
Order 140-  
No. 36  
25

130.5

25127 R  
500

at 35°C  
w.s.

Feb. 4 1881.  
Order 140-R 320  
24

128.25 U

250 127 R  
800

200/33 12/16  
200

13 12  
12 00

112

130

17

918  
130

128/2 210/17  
128

930

896

34

17  
16

1 Chms inserted.

Feb. 4 1881.  
Order 140-R 345  
29

122.85

18840  
4200 R

200/23 040/115  
200

304

200

1040

1000

40

117

130

115

115

2 Chms inserted.

650

130

130

128/14950/116  
128

215

128

870

768

102

Feb. 4, 1881.  
Order 140,  $\text{R}$  335

1305

$$\begin{array}{r} 18840 \\ 7500 \text{ R} \\ \hline 207 \overline{) 26348} \\ 131 \end{array}$$

Feb. 4, 1881.  
Order 140.  
9

1305

$$\begin{array}{r} 18840 \\ 5000 \text{ R} \\ \hline 207 \overline{) 23840} \\ 119 \text{ Dms} \end{array}$$

Feb. 4, 1881.  
Order 140 - R 310  
16

1305

$$\begin{array}{r} 18840 \\ 5000 \text{ R} \\ \hline 200 \overline{) 26840} / 134 \\ \underline{200} \\ 684 \\ \underline{600} \\ 840 \\ \underline{800} \\ 40 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{134} \\ 524 \\ \hline 390 \\ \underline{130} \\ 130 \\ \hline 130 \overline{) 17424} / 134 \\ \underline{130} \\ 442 \\ \underline{390} \\ 524 \\ \underline{520} \\ 4 \end{array}$$

Feb. 4, 1881.  
Order 140, (R)

121.50 v

$$\begin{array}{r} 18849 \text{ R} \\ 3500 \\ \hline 200 \overline{) 22340} / 111 \\ \underline{200} \\ 234 \\ \underline{200} \\ 340 \\ \underline{200} \\ 140 \end{array}$$

$$\begin{array}{r} 138 \\ \underline{112} \\ 260 \\ \hline 130 \\ \underline{130} \\ 122 \overline{) 14560} / 119 \\ \underline{122} \\ 236 \\ \underline{122} \\ 1140 \\ \underline{1098} \\ 42 \end{array}$$

119  
112  
7 Chms inserted.



Feb. 5, 1881.  
Order 39-R 335  
No. 11

118.125

$$\begin{array}{r} 18840 \\ 3800 R \\ \hline 200 \overline{) 22648} / 113 \\ \underline{200} \\ 264 \\ \underline{200} \\ 640 \\ \underline{600} \\ 40 \end{array}$$

$$\begin{array}{r} 125 \\ 113 \\ \hline 12 \text{ Chms inserted.} \end{array}$$

$$\begin{array}{r} 130 \\ 113 \\ \hline 390 \\ 130 \\ 130 \\ \hline 118 \overline{) 14690} / 124 \\ \underline{118} \\ 289 \\ \underline{236} \\ 530 \\ \underline{472} \\ 58 \end{array}$$

Feb. 5, 1881.  
Order 39-R 296  
No. 13

118.125

$$\begin{array}{r} 18840 \\ 4100 R \\ \hline 200 \overline{) 22940} / 114 \\ \underline{200} \\ 294 \\ \underline{200} \\ 940 \\ \underline{800} \\ 140 \end{array}$$

$$\begin{array}{r} 127 \\ 115 \\ \hline 12 \text{ Chms inserted.} \end{array}$$

$$\begin{array}{r} 130 \\ 115 \\ \hline 650 \\ 130 \\ 130 \\ \hline 118 \overline{) 14950} / 126 \\ \underline{118} \\ 315 \\ \underline{236} \\ 790 \\ \underline{708} \\ 82 \end{array}$$

Feb. 5, 1881.  
Order 39-R 305  
12

114.75 ✓

$$\begin{array}{r} 18840R \\ 3500R \\ \hline 200 \overline{) 22340 / 111} \\ \underline{200} \\ 234 \end{array}$$

$$\begin{array}{r} 234 \\ \underline{200} \\ 340 \end{array}$$

$$\begin{array}{r} 340 \\ \underline{200} \\ 140 \end{array}$$

$$\begin{array}{r} 127 \\ \underline{112} \\ 15 \end{array}$$

15 Chms inserted.

$$\begin{array}{r} 130 \\ \underline{112} \\ 260 \end{array}$$

$$\begin{array}{r} 260 \\ \underline{130} \\ 130 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{115} \\ 15 \end{array}$$

$$\begin{array}{r} 115 \overline{) 14560 / 126} \\ \underline{115} \\ 306 \end{array}$$

$$\begin{array}{r} 306 \\ \underline{230} \\ 760 \end{array}$$

$$\begin{array}{r} 760 \\ \underline{690} \\ 70 \end{array}$$

$$\begin{array}{r} 70 \\ \underline{70} \\ 0 \end{array}$$

Feb. 5, 1881.  
Order 39-R 310  
21

114.75

$$\begin{array}{r} 18840R \\ 3500R \end{array}$$

$$\begin{array}{r} 200 \overline{) 22340 / 111} \\ \underline{200} \\ 234 \end{array}$$

$$\begin{array}{r} 234 \\ \underline{200} \\ 340 \end{array}$$

$$\begin{array}{r} 340 \\ \underline{200} \\ 140 \end{array}$$

$$\begin{array}{r} 127 \\ \underline{112} \\ 15 \end{array}$$

15 Chms inserted

$$\begin{array}{r} 130 \\ \underline{112} \\ 260 \end{array}$$

$$\begin{array}{r} 260 \\ \underline{130} \\ 130 \end{array}$$

$$\begin{array}{r} 115 \overline{) 14560} \\ \underline{115} \\ 306 \end{array}$$

$$\begin{array}{r} 306 \\ \underline{230} \\ 760 \end{array}$$

$$\begin{array}{r} 760 \\ \underline{690} \\ 70 \end{array}$$

Feb. 5, 1881.  
Order 39-R295  
20

114.75 V

$$\begin{array}{r} 18840 \\ 3900 \text{ R} \\ \hline 200 \overline{) 22740 / 113} \\ \underline{200} \end{array}$$

$$\begin{array}{r} 274 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 740 \\ \underline{600} \end{array}$$

$$\begin{array}{r} 129 \\ \underline{114} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{114} \end{array}$$

$$\begin{array}{r} 520 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 115 \overline{) 14820 / 128} \\ \underline{115} \end{array}$$

$$\begin{array}{r} 332 \\ \underline{230} \end{array}$$

$$\begin{array}{r} 1020 \\ \underline{920} \end{array}$$

$$\begin{array}{r} 100 \end{array}$$

$$\begin{array}{r} 100 \end{array}$$

15 Chms inserted.

Feb. 5, 1881.  
Order 39-R325  
2

121.50 V

$$\begin{array}{r} 18840 \\ 3900 \text{ R} \\ \hline 200 \overline{) 22740 / 113} \\ \underline{200} \end{array}$$

$$\begin{array}{r} 274 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 740 \\ \underline{600} \end{array}$$

$$\begin{array}{r} 129 \\ \underline{114} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{114} \end{array}$$

$$\begin{array}{r} 520 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 122 \overline{) 14820} \\ \underline{122} \end{array}$$

$$\begin{array}{r} 122 \\ \underline{114} \end{array}$$

8 Chms inserted.

Feb. 5, 1881.  
Order 39-R 32.5  
28

118.125

18840 R  
4200

$$\begin{array}{r} 200 \overline{) 23040} \\ \underline{200} \phantom{0} \end{array}$$

304

200

1040

1000

130

115

655

138

130

$$118 \overline{) 14955} \quad 126$$

118

315

236

795

708

87

40 127  
115

12 Chms inserted;

Feb. 5, 1881.  
Order 39-R 32.5  
1

118.125

18840 R  
3300

$$\begin{array}{r} 200 \overline{) 22140} \\ \underline{200} \phantom{0} \end{array}$$

214

200

140

130

111

130

130

$$118 \overline{) 14438} \quad 122$$

118

263

236

270

236

34

122  
111 Chms inserted.

Feb. 5, 1881.  
Order 39-R 290  
29

115112V

$$\begin{array}{r} 18840 \\ - 3800 R \\ \hline 200 \overline{) 22640} / 113 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 264 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 640 \\ \underline{600} \end{array}$$

$$\begin{array}{r} 40 \\ \underline{40} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{113} \end{array}$$

$$\begin{array}{r} 390 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 118 \overline{) 14690} / 124 \\ \underline{118} \end{array}$$

$$\begin{array}{r} 289 \\ \underline{236} \end{array}$$

$$\begin{array}{r} 530 \\ \underline{472} \end{array}$$

$$\begin{array}{r} 58 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{113} \end{array}$$

12 Chms inserted.

Feb. 5, 1881.  
Order 32-R 280  
103 1/2 V-H

122.17V

$$\begin{array}{r} 18840 \\ - 6200 R \\ \hline 200 \overline{) 25040} / 125 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 504 \\ \underline{400} \end{array}$$

$$\begin{array}{r} 1040 \\ \underline{1000} \end{array}$$

$$\begin{array}{r} 40 \\ \underline{40} \end{array}$$

$$\begin{array}{r} 133 \\ \underline{125} \end{array}$$

8 Chms inserted.

$$\begin{array}{r} 130 \\ \underline{125} \end{array}$$

$$\begin{array}{r} 650 \\ \underline{650} \end{array}$$

$$\begin{array}{r} 260 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 122 \overline{) 16250} / 133 \\ \underline{122} \end{array}$$

$$\begin{array}{r} 405 \\ \underline{366} \end{array}$$

$$\begin{array}{r} 390 \\ \underline{366} \end{array}$$

$$\begin{array}{r} 24 \end{array}$$

Feb. 5, 1881.  
Order 32-R 290  
1000-17

118.805

18840 R  
5200

$$\begin{array}{r} 200 \overline{) 24040 / 120} \\ \underline{200} \phantom{00} \\ 404 \phantom{0} \\ \underline{400} \phantom{0} \\ 40 \phantom{0} \end{array}$$

$$\begin{array}{r} 480 \phantom{00} \\ \phantom{00} 40 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{120} \\ 10 \end{array}$$

$$\begin{array}{r} 2600 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 119 \overline{) 15600 / 131} \\ \underline{119} \phantom{00} \\ 370 \phantom{0} \\ \underline{357} \phantom{0} \\ 130 \phantom{0} \\ \underline{119} \phantom{0} \\ 11 \end{array}$$

$$\begin{array}{r} 370 \\ \underline{357} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{119} \end{array}$$

$$\begin{array}{r} 119 \\ \underline{11} \end{array}$$

$$\begin{array}{r} 119 \\ \underline{11} \end{array}$$

$$\begin{array}{r} 119 \\ \underline{11} \end{array}$$

$$\begin{array}{r} 119 \\ \underline{11} \end{array}$$

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$$\begin{array}{r} 119 \\ \underline{11} \end{array}$$

$$\begin{array}{r} 119 \\ \underline{11} \end{array}$$

$$\begin{array}{r} 119 \\ \underline{11} \end{array}$$

$$\begin{array}{r} 119 \\ \underline{11} \end{array}$$

Feb. 5, 1881.  
Order 32-R 280  
1050-2

124.835

18840 R  
7600

$$\begin{array}{r} 200 \overline{) 26440 / 132} \\ \underline{200} \phantom{00} \\ 644 \phantom{0} \\ \underline{640} \phantom{0} \\ 40 \phantom{0} \end{array}$$

$$\begin{array}{r} 480 \phantom{00} \\ \phantom{00} 40 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{120} \\ 10 \end{array}$$

$$\begin{array}{r} 2600 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{132} \\ 2 \end{array}$$

$$\begin{array}{r} 260 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 125 \overline{) 17160 / 137} \\ \underline{125} \phantom{00} \\ 466 \phantom{0} \\ \underline{375} \phantom{0} \\ 910 \phantom{0} \\ \underline{875} \phantom{0} \\ 35 \end{array}$$

$$\begin{array}{r} 390 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{125} \end{array}$$

$$\begin{array}{r} 466 \\ \underline{375} \end{array}$$

$$\begin{array}{r} 910 \\ \underline{875} \end{array}$$

$$\begin{array}{r} 35 \end{array}$$

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$$\begin{array}{r} 35 \end{array}$$

Feb. 5 1881.  
Order 32-R280  
1050-20(A)

122.85 V

$$\begin{array}{r} 18840 \\ 5400 \\ \hline 200 \overline{) 24240} / 121 \\ \underline{200} \\ 424 \\ \underline{400} \\ 240 \\ \underline{200} \\ 40 \end{array}$$

$$\begin{array}{r} 130 \\ 121 \\ \hline 130 \\ 260 \\ \hline 130 \end{array}$$

$$\begin{array}{r} 128 \\ 121 \\ \hline \end{array}$$

7 Chms inserted.

$$\begin{array}{r} 123 \overline{) 15730} / 127 \\ \underline{123} \\ 343 \\ \underline{246} \\ 970 \\ \underline{861} \\ 109 \end{array}$$

Feb. 5 1881.  
Order 32-R285  
990-18

118.12 V

$$\begin{array}{r} 18840 \\ 5900 \\ \hline 200 \overline{) 24740} / 123 \\ \underline{200} \\ 474 \\ \underline{400} \\ 740 \\ \underline{600} \\ 140 \end{array}$$

$$\begin{array}{r} 130 \\ 124 \\ \hline 520 \\ 260 \\ \hline 130 \end{array}$$

$$\begin{array}{r} 137 \\ 124 \\ \hline \end{array}$$

13 Chms inserted.

$$\begin{array}{r} 118 \overline{) 16120} / 136 \\ \underline{118} \\ 432 \\ \underline{354} \\ 780 \\ \underline{708} \\ 72 \end{array}$$

Feb. 5, 1881.  
Order 32-R 298  
103 V-13

121.50 V

18840  
6200 R  
25040

200/25040/125 <sup>45</sup> C

504  
400

1040

1000

40

130

125

650

260

130

122/16250/133

122

405

366

390

366

24

130

125

5

Chms inserted.

Feb. 5, 1881.  
Order 32-R  
14

122.80 V

18840  
7100 R  
25940

45 C

200/25940/129

594  
400

1940

1800

140

130

130

3900

130

123/16900/137

123

460

369

910

861

49

137

130

7

Chms inserted.



Feb. 5, 1881.  
Order 32-R 295  
96 U-20 (B)

118112V

$$\begin{array}{r} 18840 \\ 5200R \\ 200 \overline{) 24040/120} \\ \underline{200} \\ 4040 \\ \underline{4000} \\ 40 \end{array}$$

$$48 \text{ } \frac{132}{120} \text{ } \frac{12}{12} \text{ } \text{Chms inserted.}$$

$$\begin{array}{r} 130 \\ 120 \\ \hline 2600 \\ 130 \\ \hline 118 \overline{) 15600/132} \\ \underline{118} \\ 380 \\ \underline{354} \\ 260 \\ \underline{236} \\ 24 \end{array}$$

Feb. 5, 1881.  
Order 32-R 295  
95 1/2 U-23

120.82V

$$\begin{array}{r} 18840 \\ 5200R \\ \hline 24040. \end{array}$$

$$\begin{array}{r} 48 \text{ } \frac{132}{120} \text{ } \frac{12}{12} \text{ } \text{Chms inserted.} \\ 200 \overline{) 24040/120} \\ \underline{200} \\ 4040 \\ \underline{4000} \\ 40 \end{array}$$

$$\begin{array}{r} 130 \\ 120 \\ \hline 2600 \\ 130 \\ \hline 12 \overline{) 15600/128} \\ \underline{121} \\ 350 \\ \underline{342} \\ 80 \\ \underline{96} \\ 112 \end{array}$$

Feb. 5, 1881.  
Order 32-R 275  
9805-21

117.45 ✓

18840  
4700 R  
23540

200/23540/117  
200

354

200

1540

1400

140

130

130

117

364

351

130

117

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130

Feb. 5, 1881.  
Order 32-R 315  
102 U-8

121.50 ✓

18840  
7200 R  
200/26140/130  
200

614  
45 140

131  
130

3930

131

122/17030/130

132

483

366

1170

1098

72

140  
131

9 Chms inserted.

Feb. 5, 1881.  
Order 32-R 265  
99 U-25

118.12 ✓

18840  
4500 R  
200/23340/116  
200

834  
200  
1340  
45 140

130

117

910

130

130

118/15210/128

118

341

236

1050

944

106

129

117

12

Chms inserted

Feb. 5, 1881.  
Order 32-R 290  
101 1/2 U-9

118.12 V

$$\begin{array}{r} 18840 \\ 6500 \text{ R} \\ \hline 200 \overline{) 25340} 126 \\ \underline{200} \\ 534 \\ \underline{400} \\ 1340 \\ \underline{1200} \\ 140 \end{array}$$

$$\begin{array}{r} 130 \\ 127 \\ \hline 910 \\ 260 \\ 130 \\ \hline 118 \overline{) 16510} 139 \\ \underline{118} \\ 471 \\ \underline{354} \\ 1170 \\ \underline{1062} \\ 108 \end{array}$$

140  
127  
13 Chms inserted.

Feb. 5, 1881.  
Order 32-R 275  
100 1/2 U-7

118.12 V

$$\begin{array}{r} 18840 \\ 5500 \text{ R} \\ \hline 24340 \end{array}$$

$$\begin{array}{r} 48 \text{ C} \\ 200 \overline{) 24340} 121 \\ \underline{200} \\ 434 \\ \underline{400} \\ 340 \\ \underline{200} \\ 140 \end{array}$$

$$\begin{array}{r} 134 \\ 122 \\ \hline 12 \text{ Chms inserted} \\ 130 \\ 122 \\ \hline 260 \\ 260 \\ \hline 130 \\ 118 \overline{) 15860} 134 \\ \underline{118} \\ 406 \\ \underline{354} \\ 520 \\ \underline{472} \\ 48 \end{array}$$

Feb. 5, 1881.  
Order 32-R, 295  
105 V-26

122,85V

18840  
7100R  

---

25940

48C

200/25940/129

594  
400  
1940  
1800  

---

140

138  
130

8 Chms inserted.

130  
130  

---

3900

130  
123/16900/137

460  
369  
910  
861  

---

49

Feb. 5, 1881.  
Order 32-R, 270  
103 V-3

122,17V

18840  
6600R  

---

25440

48C

200/25440/127

544  
400  
1440  
1400  

---

40

130  
127  
918

160  
130  
122/15510/127  
122  
331  
244  
820  
864  

---

16

Feb. 5, 1881.  
Order 32-R295  
106U-4

121.50 ✓

18840  
7100 R  
25940

48 C  
200/25940/129

594  
400  
1940  
1800  
140

139  
130

9 Chms inserted.

130  
130  
3900  
130  
122/16900/138  
122  
470  
366  
1040  
976  
64

Feb. 5, 1881.  
Order 32-R290  
-27

120.15 ✓

18840  
5100 R

200/23940/119  
200  
394  
366

48 C  
1940  
1800  
140

130  
120  
2600  
130  
120/15600/130  
120  
360  
360

130  
120

10 Chms inserted

Feb. 5, 1881.  
Order 139 - R 450  
High - 1

130 ✓      130 C -

$$\begin{array}{r} 37687 \text{ R} \\ 3000 \overline{) } \\ 200 \overline{) } 40687 \overline{) } 203 \\ \underline{400} \phantom{00} \\ 687 \\ \underline{600} \\ 87 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{203} \\ 390 \\ 260 \overline{) } \\ 130 \overline{) } 26390 \overline{) } 203 \\ \underline{260} \phantom{00} \\ 390 \\ \underline{390} \phantom{00} \end{array}$$

Feb. 5, 1881.  
Order 139 - R 420  
High - 5

Went up in the Phour.  
Room.

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Feb. 5, 1881.  
Order 139-R 415  
High-2

130 ✓ 25 C

$$\begin{array}{r}
 31406 \\
 3000 \\
 \hline
 200 \overline{) 34406} \quad 172 \\
 \underline{200} \\
 1440 \\
 \underline{1400} \\
 406 \\
 \underline{400} \\
 6
 \end{array}$$

$$\begin{array}{r}
 130 \\
 172 \\
 \hline
 260 \\
 918 \\
 130 \\
 \hline
 130 \overline{) 22360} \quad 172 \\
 \underline{130} \\
 936 \\
 \underline{910} \\
 260 \\
 \underline{260}
 \end{array}$$

Feb. 5, 1881.  
Order 139-R 410  
High-13

130 ✓ 19 C

$$\begin{array}{r}
 31406 \\
 4200 \\
 \hline
 200 \overline{) 35606} \quad 1780 \\
 \underline{200} \\
 1560 \\
 \underline{1400} \\
 1600 \\
 \underline{1600} \\
 6
 \end{array}$$

$$\begin{array}{r}
 130 \\
 1780 \\
 \hline
 10400 \\
 918 \\
 130 \\
 \hline
 130 \overline{) 231400} \quad 1780 \\
 \underline{130} \\
 1014 \\
 \underline{910} \\
 1040 \\
 \underline{1040} \\
 0
 \end{array}$$



Feb. 5, 1881.  
Order 139-R 400  
10

130

✓

16c

$$\begin{array}{r} 31406 \\ 3200 \text{ R} \\ \hline 200/34606/173 \\ \underline{200} \\ 1460 \\ \underline{1400} \\ 606 \\ \underline{600} \\ 6 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{173} \\ 390 \\ 910 \\ \underline{130} \\ 130/22490/173 \\ \underline{130} \\ 849 \\ \underline{910} \\ 390 \\ \underline{390} \end{array}$$

Feb. 5, 1881.  
Order 146-R 275  
No. 7

130

✓

48c

18840  
5800 R

$$\begin{array}{r} 200/24640/123 \\ \underline{200} \\ 464 \\ \underline{400} \\ 640 \\ \underline{600} \\ 40 \end{array}$$

$$\begin{array}{r} 123 \\ \underline{130} \\ 3690 \\ 123 \\ \underline{130} \\ 130/15990/123 \\ \underline{130} \\ 299 \\ \underline{260} \\ 390 \\ \underline{390} \end{array}$$

Feb. 5, 1881.  
Order 146-R 270  
No. 6

130 ✓ 48 c

18840  
6900 R

$$200 \overline{) 25740} / 128$$

$$\begin{array}{r} 200 \\ 574 \\ 400 \\ \hline 1740 \\ 1600 \\ \hline 140 \end{array}$$

$$\begin{array}{r} 130 \\ 129 \\ \hline \end{array}$$

$$\begin{array}{r} 1170 \\ 260 \\ \hline \end{array}$$

$$130 \overline{) 16770} / 129$$

$$\begin{array}{r} 130 \\ 377 \\ 260 \\ \hline \end{array}$$

$$\begin{array}{r} 1170 \\ 1170 \\ \hline \end{array}$$

Feb. 5, 1881.  
Order 146-R 290  
No. 5

130 ✓

35 c

18840  
7700 R

$$200 \overline{) 26540} / 132$$

$$\begin{array}{r} 200 \\ 654 \\ 600 \\ \hline 540 \\ 400 \\ \hline 140 \end{array}$$

$$\begin{array}{r} 130 \\ 133 \\ \hline \end{array}$$

$$\begin{array}{r} 390 \\ 390 \\ \hline \end{array}$$

$$130 \overline{) 17290} / 133$$

$$\begin{array}{r} 130 \\ 429 \\ 390 \\ \hline \end{array}$$

$$\begin{array}{r} 390 \\ 390 \\ \hline \end{array}$$

Feb. 5, 1881.  
Order 146-R 285  
No. 4

130 ✓

18840  
6100 R

$$\begin{array}{r} 200 \overline{) 24940 / 124} \\ \underline{200} \\ 494 \\ \underline{400} \end{array}$$

48  $\frac{940}{800}$   
140

130  
125  
650

$$\begin{array}{r} 260 \\ \underline{130} \\ 130 \overline{) 16250 / 125} \\ \underline{130} \\ 325 \\ \underline{260} \\ 650 \\ \underline{650} \end{array}$$

Feb. 5, 1881.  
Order 146-R 280  
No. 3

130 ✓

38 C

18840  
8200 R

$$\begin{array}{r} 200 \overline{) 27040 / 135} \\ \underline{200} \end{array}$$

704  
600  
1040  
1000  
40

130  
135  
655

$$\begin{array}{r} 390 \\ \underline{130} \\ 130 \overline{) 17558 / 135} \\ \underline{130} \\ 455 \\ \underline{390} \\ 650 \\ \underline{650} \end{array}$$

Feb. 5, 1881.  
Order 146-R 260  
No. 2

126.90 ✓

48<sup>0</sup>

18840  
6500 R

$$\begin{array}{r} 200 \overline{) 25340 / 126} \\ \underline{200} \end{array}$$

$$\begin{array}{r} 534 \\ \underline{400} \\ 1340 \\ \underline{1200} \\ 140 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{127} \\ 30 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{127} \\ 30 \end{array}$$

3 Chms inserted.

$$\begin{array}{r} 260 \\ \underline{130} \\ 127 \overline{) 16510 / 130} \\ \underline{127} \\ 381 \\ \underline{381} \\ 0 \end{array}$$

Feb. 5, 1881.  
Order 146-R 265  
No. 1

126.90 ✓

18840  
6000 R 48<sup>0</sup>

$$\begin{array}{r} 200 \overline{) 24840 / 124} \\ \underline{200} \end{array}$$

$$\begin{array}{r} 484 \\ \underline{400} \\ 840 \\ \underline{800} \\ 40 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{124} \\ 60 \end{array}$$

$$\begin{array}{r} 127 \\ \underline{124} \\ 30 \end{array}$$

3 Chms inserted.

$$\begin{array}{r} 260 \\ \underline{130} \\ 127 \overline{) 16120 / 126} \\ \underline{127} \\ 342 \\ \underline{254} \\ 880 \\ \underline{762} \\ 118 \end{array}$$

Feb. 5, 1881.  
Order 123 - R 300  
112 1/2 U - 16

Crushed Carbon.

Feb. 5, 1881.  
Order 123 - R 310  
118 1/2 U - 28 \*

1305 200

251270

200/32627/163

200  
1262  
1200

627

600

27

130

163

390

780

130

130/21190/163

130

819

780

390

390

Feb. 5, 1881.  
Order 123-R 315  
115 U-10

130 V 22 C

25127  
6000 R

200/31127/155

1112  
1000

1127  
1000

127

130

156

780

650

130

130/20280/156

130

728

650

780

780

Feb. 5, 1881.  
Order 123-R 295  
115 1/2 U-18

130 V 26 C

25127  
3000 R

200/28127/140

812  
800

127

130

141

130

520

130

130/18330/141

130

533

520

130

130

Feb. 5, 1881.  
Order 123-R  
115 1/2 V-10 (B)

1305 230

$$\begin{array}{r} 25127 \\ 5700 \\ \hline 200 \overline{) 30827 / 154} \\ 200 \\ \hline 1082 \\ 1000 \\ \hline 827 \\ 800 \\ \hline 27 \end{array}$$

$$\begin{array}{r} 130 \\ 154 \\ \hline 20 \\ 27 \end{array}$$

$$\begin{array}{r} 650 \\ 130 \\ \hline 130 \overline{) 20020 / 154} \\ 130 \\ \hline 702 \\ 650 \\ \hline 520 \\ 520 \\ \hline \end{array}$$

Feb. 5, 1881.  
Order 124-R 255  
100 1/2 V-9

12150 V 480

18840 R  
4000

$$\begin{array}{r} 200 \overline{) 22840 / 114} \\ 200 \\ \hline 284 \\ 200 \\ \hline 840 \\ 800 \\ \hline 40 \end{array}$$

$$\begin{array}{r} 130 \\ 114 \\ \hline 520 \\ 130 \\ \hline 390 \end{array}$$

122

114

8 Chms inserted

$$\begin{array}{r} 122 \overline{) 14820 / 121} \\ 122 \\ \hline 262 \\ 244 \\ \hline 180 \\ 122 \\ \hline 58 \end{array}$$

Feb. 5, 1881.  
Order - 124 - R245  
103 1/2 V - 20

122855

48e

18840  
3000 R  
200/21840/109  
200

1840

1800

40

115

109

6 Chms inserted.

130

109

1170

130

123/14170/115

123

187

123

640

615

25

Feb. 5, 1881.  
Order 124 - R245  
103 1/2 V - 11

1241835

48e

18840  
3000 R  
200/21840/109  
200

1840

1800

40

113

109

4 Chms inserted.

130

109

1170

130

125/14170/113

125

167

125

420

375

45



Feb. 5, 1881.  
Order 124-R 275  
108 1/2 V-24

130 V 48 C

18840 R  
6700 R

200/25540/127

200  
554  
400  
1540  
1400  
140

130  
128  
1040  
260

130  
130  
130/16640/128  
364  
260  
1040  
1040

Feb. 5, 1881.  
Order 124-R 280  
112 1/2 V-29

126.90 V

18840 R 48 C  
6000 R

200/24840/124

200  
484  
400  
840  
800

130  
124  
40

127  
124  
3 Chms inserted.

520  
260  
130  
127  
127/16120/126  
342  
254  
880  
762  
118

Feb. 5, 1881.  
Order 124-R230  
98V-2

119.47V 48C

$$\begin{array}{r} 18840 \\ 1200 \\ 200 \overline{) 28148/10} \\ \underline{200} \\ 140 \end{array}$$

$$\begin{array}{r} 130 \\ 11 \\ 130 \\ 130 \\ 119 \overline{) 1430/12} \\ \underline{119} \\ 240 \\ \underline{238} \\ 2 \end{array}$$

12  
11 Chms inserted.

Feb. 5, 1881.  
Order 124-R250  
99 1/2 V-12

119.47V

$$\begin{array}{r} 18840 \\ 4200 \\ 200 \overline{) 23840/115} \\ \underline{200} \\ 384 \end{array}$$

$$\begin{array}{r} 304 \\ 200 \\ 1040 \\ 1000 \\ 130 \\ 115 \\ 650 \\ 130 \\ 130 \\ 119 \overline{) 14950/125} \\ \underline{119} \\ 305 \\ \underline{238} \\ 670 \\ \underline{595} \\ 75 \end{array}$$

126  
115  
11 Chms inserted.

Feb. 5, 1881.  
Order 124-R275  
102 1/2 V-23

120.15 V

$$\begin{array}{r}
 18840 \\
 5300 \text{ R} \\
 \hline
 200 \overline{) 24140 / 120} \\
 \underline{200} \\
 414 \\
 \underline{400} \\
 140
 \end{array}$$

$$\begin{array}{r}
 130 \\
 121 \\
 \hline
 130
 \end{array}$$

$$\begin{array}{r}
 131 \\
 121 \\
 \hline
 10 \text{ Chms. inserted.}
 \end{array}$$

$$\begin{array}{r}
 260 \\
 130 \\
 \hline
 120 \overline{) 15730 / 131} \\
 \underline{120} \\
 373 \\
 \underline{360} \\
 130 \\
 \underline{120} \\
 10
 \end{array}$$

Feb. 5, 1881.  
Order 124-R290  
101 1/2 V-15

120.82 V 48 C

$$\begin{array}{r}
 18840 \\
 5300 \text{ R} \\
 \hline
 200 \overline{) 24140 / 120} \\
 \underline{200} \\
 414 \\
 \underline{400} \\
 140
 \end{array}$$

$$\begin{array}{r}
 130 \\
 121 \\
 \hline
 130
 \end{array}$$

$$\begin{array}{r}
 130 \\
 121 \\
 \hline
 9 \text{ Chms. inserted.}
 \end{array}$$

$$\begin{array}{r}
 260 \\
 130 \\
 \hline
 121 \overline{) 15730 / 138} \\
 \underline{121} \\
 363 \\
 \underline{363} \\
 0
 \end{array}$$

Feb. 5, 1881.  
Order 124 - R 260  
99 1/2 V-8

121.50 V 48C

18840  
3600 R  
200/22440/112  
200  
244  
200  
440  
400  
40

138  
112  
260  
138  
130  
122/14568/119  
122  
236  
122  
1140  
1098  
42

119  
112  
7 Chms inserted.

Feb. 5, 1881.  
Order 124 - R 250  
105 V-21

121.50 V 48C

18840  
4200 R  
200/23040/115  
200  
304  
200  
1040  
1000  
40

130  
115  
650  
130  
130  
122/14950/122  
122  
275  
244  
310  
244  
66

123  
115  
8 Chms inserted.

Feb. 5, 1881.  
Order 124-R 255  
9 1/2 U-19

118125 480

$$\begin{array}{r} 18840 \\ 3400R \\ \hline 200 \overline{) 22240} \quad 111 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 130 \\ 111 \\ \hline 130 \\ 130 \\ \hline 130 \end{array}$$

$$\begin{array}{r} 40 \\ 122 \\ 111 \\ \hline 11 \end{array}$$
 Chms inserted.

Feb. 5, 1881.  
Order 124-R 255  
104 U-14

1201 155 48e

$$\begin{array}{r} 18840 \\ 4200R \\ \hline 200 \overline{) 23040} \quad 115 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 130 \\ \underline{115} \\ 650 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{130} \\ 120 \end{array}$$

$$\begin{array}{r} 120 \overline{) 14950} \\ \underline{120} \\ 295 \\ \underline{240} \\ 550 \\ \underline{480} \\ 70 \end{array}$$

Feb. 5, 1881.  
Order 124-R 285  
105 1/2 V-20

120.15 ✓

48C

18840  
4700 R

200/23540/117  
200

354

200

1540

1400

140

130

118

1040

130

130

120

120

334

240

940

840

100

120/15340/127  
120

334

240

940

840

100

128

118

10

Chms inserted.

Feb. 5, 1881.  
Order 48-R 270  
106 V-4

124.83 ✓

18840  
3000 R

200/21840/109  
200

1840

1800

40

130

109

1170

130

125

167

125

420

375

45

125/14170/113  
125

167

125

420

375

45

113

109

4

Chms inserted

118

Feb. 5, 1881.  
Order 48 - R 300  
104 1/2 V-17

119

Feb. 5, 1881.  
Order 48 - R 285  
100 1/2 V-6

120

Feb. 5, 1881.  
Order 48 - R280.  
103 1/2 V-7

121

Feb. 5, 1881.  
Order 48 - R275  
99 1/2 V-14



Feb. 5, 1881.  
Order 47-R 210  
96½ U-8

114.75 Volts

$$\begin{array}{r}
 18840 \\
 1000 \\
 \hline
 200 \overline{) 19840} 99 \\
 \underline{18000} \\
 1840 \\
 \underline{1800} \\
 40 \quad 112 \\
 130 \quad 99 \\
 99 \quad 13 \text{ Chms inserted.} \\
 \hline
 1170 \\
 1170 \\
 \hline
 115 \overline{) 12870} 111 \\
 \underline{1150} \\
 132 \\
 115 \\
 \hline
 220 \\
 115 \\
 \hline
 105
 \end{array}$$

Feb. 5, 1881.  
Order 47-R 225  
95 U-9

116.10 Volts

$$\begin{array}{r}
 18840 \\
 2200 \\
 \hline
 200 \overline{) 21040} 105 \\
 \underline{20000} \\
 1040 \\
 1000 \\
 \hline
 40 \quad 118 \\
 130 \quad 105 \\
 105 \quad 13 \text{ Chms inserted.} \\
 \hline
 650 \\
 130 \\
 116 \overline{) 13650} 117 \\
 \underline{1160} \\
 205 \\
 116 \\
 \hline
 890 \\
 812 \\
 \hline
 68
 \end{array}$$

Feb. 5, 1881.  
Order 144-R 225  
106U-23

Feb. 5, 1881.  
Order 144-R 305  
2

Feb. 5, 1881.  
Order 144-R 340  
116 V-15

Feb. 5, 1881.  
Order 144-R  
3

128

Feb. 5, 1881.  
Order 144-R270  
103 1/2 B-27

129

Feb. 5, 1881.  
Order 144-R240  
112 1/2 B-11

130

Feb. 5, 1881.  
Order 144-R 260  
22

131

Feb. 5, 1881.  
Order 144-R 285  
111 1/2 V-17

132

Feb. 5, 1881.  
Order 144-R 330  
114 1/2 V-6

133

Feb. 5, 1881.  
Order 144-R 310  
6

134

Feb. 5, 1881.  
Order 144-R 290  
1110-18

135

Feb. 5, 1881.  
Order 144-R 230  
4

136

Feb. 5, 1881.  
Order 144-R 250  
28

137

Feb. 5, 1881.  
Order 144-R 295  
111/2 F-9



138

Feb. 5, 1881.  
Order 144-R 270  
99 1/2 U-26.

139

Feb. 5, 1881.  
Order 144-R 290  
29

140

Feb. 7, 1881.  
Order 129 - High  
14

This one carbon is bus. 14

141

Feb. 7, 1881.  
Order 47 - R 235  
97V-19

114.75 V

188.40  
3000 R

48e

Feb. 7, 1881.  
Order 43-R275  
118V-17

1305 35<sup>c</sup>

25127  
3300R  
200 | 28427  
142

Feb. 7, 1881.  
Order 47-R225  
99V-12

118.125

1884.0  
2800R  
200 | 216.40  
108

48<sup>c</sup>

Feb. 7, 1881.

Order 47-R225  
96V-10

120.15-v

$$\begin{array}{r}
 18840 \\
 1100R \\
 \hline
 200 \overline{) 19940} \\
 40099.
 \end{array}$$

Feb. 7, 1881.

Order 43-R299  
High-12

130v at 18c

$$\begin{array}{r}
 25127R \\
 4900 \\
 \hline
 200 \overline{) 30027} \\
 150
 \end{array}$$

Feb. 7, 1881.  
Order 43-R 29.6  
110 V-4

130 V

$$\begin{array}{r} 25127 \\ 3300 \overline{) 21827} \\ \underline{109} \end{array}$$

48 C

Feb. 9, 1881.  
Order 156-R 340  
No. 6

111.34 Volts. - 48 C.

$$\begin{array}{r} 12560 \\ 5200 \\ 200 \overline{) 17760} / 88 \\ \underline{1600} \\ 1760 \\ \underline{1600} \\ 160 \end{array}$$

$$\begin{array}{r} 130 \\ 89 \end{array}$$

$$\begin{array}{r} 90 \\ 88 \end{array}$$

2 Chunks inserted.

$$\begin{array}{r} 1170 \\ 880 \\ 111 \overline{) 9970} / 89 \\ \underline{880} \\ 1090 \\ \underline{999} \\ 91 \end{array}$$

Feb. 9, 1881.  
Order 156-R 365  
No. 9

104.62 Volts.

$$\begin{array}{r} 18840 \\ 52400 \\ \hline 200 \overline{) 24240} / 121 \\ \underline{200} \\ 424 \\ \underline{400} \\ 240 \\ \underline{200} \\ 40 \end{array}$$

$$\begin{array}{r} 121 \\ 130 \\ \hline 3630 \end{array}$$

$$\begin{array}{r} 121 \\ \hline 105 \overline{) 15730} / 149 \\ \underline{105} \\ 523 \\ \underline{420} \\ 1030 \\ \underline{945} \\ 85 \end{array}$$

$$\begin{array}{r} 150 \\ 121 \\ \hline 29 \text{ Chms inserted.} \end{array}$$

Feb. 9, 1881.  
Order 156-R 390  
No. 3

111.34V

$$\begin{array}{r} 12560 \\ 6200 \\ \hline 200 \overline{) 18760} / 93 \\ \underline{1800} \\ 760 \\ \underline{600} \\ 160 \end{array}$$

$$\begin{array}{r} 130 \\ 94 \\ \hline 520 \end{array}$$

$$\begin{array}{r} 110 \\ 94 \\ \hline 6 \text{ Chms inserted.} \end{array}$$

$$\begin{array}{r} 1170 \\ \hline 111 \overline{) 12220} / 110 \\ \underline{111} \\ 112 \\ \underline{111} \\ 10 \end{array}$$

Feb. 9, 1881.  
Order 43-R-299  
High-12

130.27 U-38C.

$$\begin{array}{r} 18840 \\ 9700 \\ \hline 200 \overline{) 28540} 142 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 854 \\ 800 \\ \hline 540 \\ 400 \\ \hline 140 \end{array}$$

$$\begin{array}{r} 130 \\ 143 \\ \hline 390 \\ 520 \\ \hline 130 \\ \hline 130 \overline{) 18590} 143 \\ \underline{130} \\ 559 \\ 520 \\ \hline 390 \\ 390 \end{array}$$

Feb. 9, 1881.  
Order 156-R 375  
No. 4

114.75 ✓

$$\begin{array}{r} 200 \overline{) 18900} 94 \\ \underline{1800} \\ 700 \\ \underline{600} \\ 100 \end{array}$$

$$\begin{array}{r} 130 \\ 94 \\ \hline 520 \\ 1170 \\ \hline 130 \overline{) 12220} 94 \\ \underline{1170} \\ 520 \\ 520 \end{array}$$

Feb. 9, 1881.  
Order 156-R 385  
No. 1

114.75 ✓

18840  
800 R

$$\begin{array}{r} 200 \overline{) 19640} / 98 \\ \underline{18000} \\ 1640 \end{array}$$

$$\begin{array}{r} 1640 \\ \underline{1600} \\ 40 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{98} \\ 32 \end{array}$$

$$\begin{array}{r} 1040 \\ \underline{1170} \end{array}$$

$$\begin{array}{r} 115 \overline{) 12740} / 110 \\ \underline{115} \end{array}$$

$$\begin{array}{r} 124 \\ \underline{115} \\ 90 \end{array}$$

111  
98  
3/Chms inserted.

Feb. 9, 1881.  
Order 156-R 410  
No. 8

111.34 ✓

12560  
5800 R

$$\begin{array}{r} 200 \overline{) 18360} / 91 \\ \underline{18000} \\ 360 \end{array}$$

$$\begin{array}{r} 360 \\ \underline{200} \\ 160 \end{array}$$

$$\begin{array}{r} 130 \\ \underline{92} \end{array}$$

$$\begin{array}{r} 260 \\ \underline{1170} \end{array}$$

$$\begin{array}{r} 111 \overline{) 11960} / 107 \\ \underline{111} \end{array}$$

$$\begin{array}{r} 860 \\ \underline{777} \\ 83 \end{array}$$

$$\begin{array}{r} 108 \\ \underline{92} \end{array}$$

16 Chms inserted.



Feb. 9, 1881.  
Order 156-R 390  
No. 3

114.75 ✓

125.60 R  
60.00

18 560

48 C  
200/18560/92  
1800

130  
93  
390  
1170

115/12090/105  
115  
590  
575  
15

105  
93  
12 Chms inserted

Feb. 9, 1881.  
Order 156-R 340  
No. 6

109.35 ✓

125.60 R  
54.00

200/17960/89  
1600  
1960  
1800  
160

48 C  
130  
89  
1170  
1040

109/11570/106  
109  
670  
654  
16

106  
90  
16 Chms inserted.

Feb. 9, 1881.  
Order 156-R 365  
9/10.9

108. ✓

$$\begin{array}{r} 12560 \\ \underline{6500} \\ 200 \overline{) 19060} \quad 0/95 \\ \underline{18000} \\ 1060 \\ \underline{1000} \\ 60 \end{array}$$

$$\begin{array}{r} 130 \\ 96 \\ \hline 780 \\ 1170 \\ \hline 108 \overline{) 12480} \end{array}$$

Feb. 15, 1881.  
Order 145 - R 325  
3

1205 CIR

$$\begin{array}{r} 25127R \\ \underline{8000} \\ 200 \overline{) 33127} \\ \underline{165} \quad \begin{array}{l} 127 \\ 254 \end{array} \end{array}$$
$$\begin{array}{r} 166 \\ \times 130 \\ \hline 4980 \\ 166 \phantom{0} \\ \hline 130 \overline{) 21580} \phantom{0} \overline{) 166} \\ \underline{130} \phantom{0} \\ 858 \phantom{0} \\ \underline{780} \phantom{0} \\ 780 \\ \underline{780} \\ 0 \end{array}$$

Feb. 15, 1881.  
Order 145-R300.  
8

130 ✓ 250

$$\begin{array}{r}
 25127 \\
 25000 \\
 \hline
 200 \overline{) 28627143} \\
 \underline{2000} \\
 862 \\
 \underline{800} \\
 627 \\
 \underline{600} \\
 27 \\
 110 \\
 \underline{130}
 \end{array}$$

Feb. 15, 1881.  
Order 140-R345  
No. 12

130 ✓ 230

$$\begin{array}{r}
 25127 \\
 8000 \\
 \hline
 200 \overline{) 33127165} \\
 \underline{2000} \\
 1312 \\
 \underline{1200} \\
 1127 \\
 \underline{1000} \\
 127
 \end{array}$$

Feb. 15, 1881.  
Order 140-R 275  
No. 13

130  
bush

Feb. 15, 1881.  
Order 130-R 175  
No. 75

112.72 ✓  
48 c

18840  
300

200/19140/95  
1800

1140  
1000  
140

130

96

780

1170

113/12480/110  
113

118

113

50

111

96

15 Chms inserted.

Feb. 15, 1881.  
Order 158-R  
No. 1

120.15 ✓

48 c

18840 R  
2100

$$\begin{array}{r} 200 \overline{) 20940} \quad 104 \\ \underline{200} \phantom{00} \\ 940 \phantom{00} \\ \underline{800} \phantom{00} \\ 140 \phantom{00} \end{array}$$

$$\begin{array}{r} 105 \\ \underline{130} \\ 3150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 105 \\ \underline{120} \\ 150 \end{array}$$

$$\begin{array}{r} 114 \\ 105 \\ \hline 9 \text{ Chms inserted.} \end{array}$$

$$\begin{array}{r} 120 \overline{) 13650} \quad 113 \\ \underline{120} \phantom{00} \\ 165 \phantom{00} \\ \underline{120} \phantom{00} \\ 450 \phantom{00} \\ \underline{360} \phantom{00} \\ 90 \phantom{00} \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

$$\begin{array}{r} 165 \\ \underline{120} \\ 450 \end{array}$$

Feb. 15, 1881.  
Order 158-R  
No. 2

121.50 ✓

48 c

18840 R  
6100

$$\begin{array}{r} 200 \overline{) 24940} \quad 124 \\ \underline{200} \phantom{00} \\ 494 \phantom{00} \\ \underline{400} \phantom{00} \\ 940 \phantom{00} \\ \underline{800} \phantom{00} \\ 140 \phantom{00} \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 125 \\ \underline{130} \\ 3750 \end{array}$$

$$\begin{array}{r} 122 \overline{) 16250} \quad 133 \\ \underline{122} \phantom{00} \\ 405 \phantom{00} \\ \underline{366} \phantom{00} \\ 390 \phantom{00} \\ \underline{366} \phantom{00} \\ 24 \phantom{00} \end{array}$$

$$\begin{array}{r} 183 \\ 125 \\ \hline 8 \text{ Chms inserted.} \end{array}$$

Feb. 15, 1881.  
Order 158-R  
No. 3

111.34 ✓

48 e

18840 R  
2000

200/20840/104

840  
800

104  
130

40

122  
104

18 Chms inserted.

111/13520/121  
111

242

222

200

111

89

Feb. 15, 1881.  
Order 158-  
No. 4

114.75 ✓

48 e

18840 R  
3900

200/22740/113

274  
200

740  
600

140

114

130

3420

114

115/14820/128

332

230

1020

920

100

129

114

5 Chms inserted.

Feb. 15, 1881.  
Order 158-R  
No. 5

130 ✓

31c

25127  
2900

$$\begin{array}{r} 200 \overline{) 28927} \quad / 140 \\ \underline{200} \phantom{00} \\ 892 \\ \underline{800} \phantom{0} \\ 92 \phantom{0} \\ \underline{80} \phantom{0} \\ 12 \phantom{0} \end{array}$$

Feb. 15, 1881.  
Order 158-  
No. 6

12150 ✓

48c

18840  
2800 R

$$\begin{array}{r} 200 \overline{) 21640} \quad / 108 \\ \underline{200} \phantom{00} \\ 1640 \end{array}$$

$$\begin{array}{r} 108 \\ \underline{130} \phantom{0} \\ 3240 \end{array}$$

$$\begin{array}{r} 108 \\ \underline{122} \phantom{00} \\ 14040 \quad / 115 \\ \underline{122} \phantom{00} \\ 184 \phantom{0} \end{array}$$

$$\begin{array}{r} 184 \\ \underline{122} \phantom{0} \\ 620 \\ \underline{610} \phantom{0} \\ 10 \end{array}$$

$$\begin{array}{r} 115 \\ \underline{108} \phantom{0} \\ 7 \end{array}$$

7 Chms inserted.

Feb. 15, 1881.  
Order 158  
No. 7

118.12 V

45 C

18840  
3500 R

$$\begin{array}{r} 200 \overline{) 22340} \quad 111 \\ \underline{200} \phantom{00} \\ 234 \phantom{00} \\ \underline{200} \phantom{00} \\ 340 \phantom{00} \\ \underline{200} \phantom{00} \\ 140 \phantom{00} \end{array}$$

112  
130

3360

112

$$\begin{array}{r} 118 \overline{) 14560} \quad 123 \\ \underline{118} \phantom{00} \\ 276 \phantom{00} \\ \underline{236} \phantom{00} \\ 400 \phantom{00} \\ \underline{354} \phantom{00} \\ 46 \phantom{00} \end{array}$$

276

236

400

354

46

123

112

11 Chms inserted.

Feb. 15, 1881.  
Order 138 - R285  
110 V — 28

124.83 V

48 C

18840  
4100 R

$$\begin{array}{r} 200 \overline{) 22940} \quad 114 \\ \underline{200} \phantom{00} \\ 294 \phantom{00} \\ \underline{200} \phantom{00} \\ 940 \phantom{00} \\ \underline{800} \phantom{00} \\ 140 \phantom{00} \end{array}$$

115

130

3450

115

$$\begin{array}{r} 125 \overline{) 14950} \quad 119 \\ \underline{125} \phantom{00} \\ 245 \phantom{00} \\ \underline{125} \phantom{00} \\ 1200 \phantom{00} \\ \underline{1125} \phantom{00} \\ 75 \phantom{00} \end{array}$$

125

245

125

1200

1125

75

120

115

5 Chms inserted.



Feb. 15, 1881.  
Order 157-  
No. 10

111.34 ✓

48 C

$$\begin{array}{r} 12560 \\ 4700 \\ \hline 200 \overline{) 17260} \phantom{0} / 86 \\ \underline{1600} \phantom{0} \\ 1260 \\ \underline{1200} \\ 60 \end{array}$$

$$\begin{array}{r} 87 \\ 130 \\ \hline \end{array}$$

$$\begin{array}{r} 2610 \\ 87 \\ \hline \end{array}$$

$$\begin{array}{r} 111 \overline{) 11310} / 101 \\ \underline{111} \phantom{0} \\ 210 \\ \underline{111} \\ 99 \end{array}$$

$$\begin{array}{r} 102 \\ 87 \\ \hline \end{array}$$

15 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 11

110.02 ✓

45 C

$$\begin{array}{r} 12560 \\ 4300 \\ \hline 200 \overline{) 16860} \phantom{0} / 84 \\ \underline{1600} \phantom{0} \\ 860 \\ \underline{800} \\ 60 \end{array}$$

$$\begin{array}{r} 85 \\ 130 \\ \hline \end{array}$$

$$\begin{array}{r} 2550 \\ 85 \\ \hline \end{array}$$

$$\begin{array}{r} 110 \overline{) 11050} / 100 \\ \underline{110} \phantom{0} \\ 50 \end{array}$$

$$\begin{array}{r} 111 \\ 85 \\ \hline \end{array}$$

16 Chms inserted.

Feb. 15, 1881.  
Order 157-R  
No. 12

116.10 V  
45 C

18540 R  
300 R

200/19140/95  
1800

1140  
1000

96  
130

2880

96

186/12480/107

116  
888  
812  
68

108  
96  
12 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 13

113.40 V  
48 C

12560 R  
5700 R

200/17660/88  
1600

1660  
1600  
60

89  
130

2670

89

113/11570/102

113  
270  
226  
44

102  
89

13 Chms inserted.

Feb. 15, 1881.  
Order 157  
No. 14

121.50 ✓

248 C

18840 R  
1700

200/20540/102

540  
400  
140

103  
130

3090

103

122/13390/109

122  
1190  
1098

9.2

110  
103  
7 Chms inserted.

Feb. 15, 1881.  
Order 157  
No. 15

109.35 ✓

48 C

~~18840~~

12560 R  
4500

200/17060/85

86  
130  
2580  
86

1060  
1000  
60

109/11180/102

109  
280  
218  
62

103  
86  
17 Chms inserted.

Feb. 15, 1881.  
Order 157  
No. 16

111.34 ✓

48 C

12560

3200

200/15760/78  
1400

78  
130  
2370  
79  
10270/92  
999  
280  
222  
58

93

79

14 Chms inserted.

Feb. 15, 1881.  
Order 157  
No. 17

111.34 ✓

48 C

12560

4800

200/17360/86  
1600

87  
130  
2610  
87  
111310/101  
111  
210  
111  
99

102

87

15 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 9

111.34 ✓

48 e

12560 R  
5100 R

200/17660/88  
1600

89  
130  
2670  
89  
111570/104  
111  
470.  
444  
26

104  
89  
15 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 8

111.34 ✓

48 e

12560 R  
3500 R

200/16060/80  
1600  
60

81  
130  
2430  
81

95  
81  
14 Chms inserted.

111/10530/94  
999  
540  
444  
96

Feb. 15, 1881.  
Order 157-  
No. 7

111.34 ✓

48 C

~~25~~

12560  
3700

200/16260/81

82  
130  
2460  
82  
260  
200  
60

111/10660/96  
999  
670  
666  
4

96  
82  
14 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 6

111.34 ✓

48 C

12560  
4000

200/16560/82

560  
400  
160  
83  
130  
2490  
83



111/10790/97  
999  
800  
777  
23

97  
83  
14 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 5

113.40 ✓

45 

1256 0   
540 0 

200/1796 0/89  
1600

1960  
1800  
160

90  
130

2700

90

113/11700/103  
113

400

339

61


104



90

14 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 4

114.75 ✓

48 

1256 0   
510 0 

200/1766 0/88  
1600

1660  
1600  
60

81  
130

2430

81

115/12530/91  
1035

180

115

65

92

89

3 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 3

114.84 ✓

480

12560

5200

200/1,760 60/88

89  
130  
2670  
89

1,760  
160

117/1157.0/104

111  
470  
444  
26

105  
89  
16 Chms inserted.

Feb. 15, 1881.  
Order 157-  
No. 2

113.40 ✓

480

12560

5000

200/1,756 0/870

1560  
1400  
160

88  
130  
2640  
88

113/11440/101

113  
140  
113  
27

101

88

13 Chms inserted.



Feb. 15, 1881.  
Order 157-  
No. 1

114175 ✓  
45 C

12560  
6600  
200/19160/95  
1800  
1160  
1000  
160

96  
130  
2880  
96

109  
96  
13 Clums. insertos.

115/12480/108  
115

980  
920  
60

Feb. 15, 1881.  
Order 146-R 280  
No. 15

1200 ✓  
35 C

18840  
7800

200/26640/133  
200  
664  
600

133  
130  
3990  
133

139/17290/133  
1130  
429  
390  
390  
390

Feb. 15, 1881.  
Order 146-R 280  
No. 13

180 ✓

~~48~~

35

18840  
8000

200/26840/134

$$\begin{array}{r} 134 \\ 130 \\ \hline 4020 \\ 134 \\ \hline 130/17420/134 \\ \hline 130 \\ 442 \\ 390 \\ \hline 520 \\ 520 \end{array}$$

Feb. 15, 1881.  
Order 37-R 235  
No. 17

124.83 ✓

48

18840  
2800

$$\begin{array}{r} 200/21640/108 \\ \hline 200 \\ \hline 1640 \\ 1600 \\ \hline 40 \end{array}$$

$$\begin{array}{r} 108 \\ 130 \\ \hline 3240 \\ 108 \\ \hline 125/14040/112 \\ \hline 125 \end{array}$$

$$\begin{array}{r} 154 \\ 125 \\ \hline 290 \\ 250 \\ \hline 40 \end{array}$$

$$\begin{array}{r} 112 \\ 108 \\ \hline .4 \text{ Chimes inserted} \end{array}$$

Feb. 15, 1881.  
Order 37-R 230  
9/10.18

121.50 ✓

48c

18840  
900

200/18740/98

1740  
1600

98 140

130

2970

99

22/12870/105

670  
610  
60

106

98

7 Chms inserted.

Feb. 15, 1881.  
Order 192-R 210  
105 1/2 U-13

119.47 ✓

18840  
2700

48c

200/21540/107

108

130

3240

108

119/14040/117

119

214

119

950

833

117

1540

1400

140

118

108

10 Chms inserted.

Feb. 15, 1881.  
Order 192 - R 210  
103 1/2 U - 12

117145 ✓

18840

200 R

480

$$\begin{array}{r}
 200 \overline{) 19140 / 95} \\
 \underline{1800} \phantom{00} \\
 96 \phantom{00} \\
 130 \phantom{00} \\
 \underline{2880} \phantom{00} \\
 96 \phantom{00} \\
 117 \overline{) 12480 / 106} \\
 \underline{117} \phantom{00} \\
 780 \phantom{00} \\
 \underline{702} \phantom{00} \\
 78 \phantom{00}
 \end{array}$$

107  
96

11 Chms insertos.

Feb. 15, 1881.  
Order 192 - R 200  
106 U - 19

12015 ✓

18840

3100 R

480

$$\begin{array}{r}
 200 \overline{) 21940 / 109} \\
 \underline{200} \phantom{00} \\
 1940 \phantom{00} \\
 1800 \phantom{00} \\
 \underline{140} \phantom{00} \\
 110 \phantom{00} \\
 130 \phantom{00} \\
 \underline{3300} \phantom{00} \\
 110 \phantom{00} \\
 120 \overline{) 14300 / 119} \\
 \underline{120} \phantom{00} \\
 230 \phantom{00} \\
 \underline{120} \phantom{00} \\
 1100 \phantom{00} \\
 \underline{1080} \phantom{00} \\
 20 \phantom{00}
 \end{array}$$

9 Chms insertos.

Feb. 15, 1881.  
Order 192-R/95  
104 1/2 U-14

119147U

18840  
2000R

4re

200/20840/104

104  
130  
3120

840  
800  
40

119/13520/113  
119

162  
119

430  
367

73

114  
104  
10 Chms inserted.

Feb. 15, 1881.  
Order 192-R/205  
100 1/2 U-8

11812 V 4re

18840  
500R

200/19340/96

1800  
1340  
1200

140

97  
130

2910

97

118/12610/106

118  
810

708

102

107

97

10

Chms inserted.

Feb. 15, 1881.  
Order 192-R200  
107 1/2 U-18

120.15 V 48e

18840  
2500 R

$$\begin{array}{r} 200 \overline{) 21340 / 106} \\ \underline{200} \\ 1340 \\ \underline{1200} \\ 140 \end{array}$$

$$\begin{array}{r} 107 \overline{) 130} \\ \underline{107} \\ 230 \\ 107 \overline{) 13910 / 115} \\ \underline{120} \\ 191 \\ \underline{120} \\ 710 \\ \underline{600} \\ 110 \end{array}$$

116  
107  
9 Chms inserted.

Feb. 15, 1881.  
Order 192-R195  
110 U-22

121.50 U 48e

18840  
1600 R

$$\begin{array}{r} 200 \overline{) 28440 / 102} \\ \underline{200} \\ 840 \\ \underline{800} \\ 40 \end{array}$$

$$\begin{array}{r} 102 \overline{) 130} \\ \underline{102} \\ 280 \\ 102 \overline{) 13260 / 108} \\ \underline{122} \\ 1060 \\ \underline{976} \\ 84 \end{array}$$

109  
102  
7 Chms inserted.

Feb. 15, 1881.  
Order 192-R300  
109V-9.

118.125 480

18840  
3000

$$\begin{array}{r} 200 \overline{) 21840 / 109} \\ \underline{200} \\ 1840 \\ \underline{1800} \\ 40 \end{array}$$

109  
130

3270

109

118 | 14170 / 120

118

237

236

10

120  
109

11 Chms inserted.

Feb. 15, 1881.  
Order 192-R345  
105 1/2 V-18

118.125 480

18840  
2500

$$\begin{array}{r} 200 \overline{) 21340 / 106} \\ \underline{200} \\ 1340 \\ \underline{1200} \\ 140 \end{array}$$

107  
130

3210

107

118 | 13910 / 117

118

211

118

930

826

104

118

107

11 Chms inserted.

Feb. 15, 1881.  
Order 192-R200  
101-8-4

115.435 48e

18840  
1200

$$\begin{array}{r} 200 \overline{) 20040/100} \\ \underline{200} \\ 40 \end{array}$$

$$\begin{array}{r} 100 \\ \underline{130} \\ 3000 \\ \underline{100} \\ 115 \overline{) 3000/113} \\ \underline{115} \\ 150 \\ \underline{115} \\ 350 \\ \underline{345} \\ 5 \end{array}$$

$$\begin{array}{r} 113 \\ \underline{100} \\ 13 \text{ Chms inserted.} \end{array}$$

Feb. 15, 1881.  
Order 192-R215  
105-8-5

118.125 48e

18840  
2500

$$\begin{array}{r} 200 \overline{) 21340/106} \\ \underline{200} \\ 1340 \\ \underline{1200} \\ 140 \end{array}$$

$$\begin{array}{r} 107 \\ \underline{130} \\ 3210 \\ \underline{107} \\ 118 \overline{) 13910/117} \\ \underline{118} \\ 211 \\ \underline{118} \\ 930 \\ \underline{826} \\ 104 \end{array}$$

$$\begin{array}{r} 118 \\ \underline{107} \\ 11 \text{ Chms inserted.} \end{array}$$



Feb. 15, 1881.  
Order 192-R325  
105 1/2 U-6

120.15 U 480

18840  
1500  
200/203 40/101  
200  
340  
200  
140

102  
130  
3060

102  
120/13260/110  
120  
126  
120  
60

111  
102  
9 Chms inserted

Feb. 15, 1881.  
Order 192-R200  
100 1/2 U-1

120.15 U 480

18840  
4750  
200/2359 0/117  
200  
359  
200

1590  
1400  
190

118  
130  
3540  
118  
120/15340/127  
120  
334  
240  
940  
840  
100

128  
118  
10 Chms inserted

Feb. 15, 1881.  
Order 192 - R205  
99 1/2 V-8

114.75 ✓ 48e  
18840  
1200

200/200 40/100  
200  
40

100  
130  
3000  
100  
115/3000/113  
115  
150  
115  
350  
345  
5

113  
100  
13 Chms inserted.

Feb. 15, 1881.  
Order 192 - R205  
103 1/2 V-7

116.10 ✓ 48e

18840  
2300

200/21140/105  
200  
1140  
1000  
140

106  
130  
3180  
106  
119  
106  
13 Chms inserted.  
106  
116/13780/118  
116  
218  
116  
1020  
928  
92

Feb. 15, 1881.  
Order 192-R 210  
98 1/2 U-14

118.125 48C

$$\begin{array}{r} 18540 \\ 1200 \overline{) 20020040/100} \\ \underline{200} \phantom{00} \\ 40 \end{array}$$

$$\begin{array}{r} 100 \\ 130 \\ 118 \overline{) 13000/110} \\ \underline{118} \phantom{00} \\ 120 \\ \underline{118} \\ 20 \end{array}$$

110  
100 Chms inserted.

Feb. 15, 1881.  
Order 192-R 236  
109 1/2 U-21

124.835 48C

$$\begin{array}{r} 18540 \\ 4900 \overline{) 20023740/118} \\ \underline{200} \phantom{00} \\ 374 \\ \underline{200} \phantom{00} \\ 1740 \\ \underline{1600} \phantom{00} \\ 140 \end{array}$$

$$\begin{array}{r} 119 \\ 130 \\ 3570 \end{array}$$

$$\begin{array}{r} 1740 \\ 1600 \\ 140 \end{array}$$

$$\begin{array}{r} 124 \\ 119 \end{array}$$

5 Chms inserted.

$$\begin{array}{r} 119 \\ 125 \overline{) 15470/123} \\ \underline{125} \phantom{00} \\ 297 \\ \underline{250} \phantom{00} \\ 470 \\ \underline{375} \phantom{00} \\ 95 \end{array}$$

Feb. 15, 1881.  
Order 192-R215  
101 V-5

1201155 480

18840  
2500

200/21340/106  
200

1340  
1200  
140

107  
130  
3210

107  
120/13910/115  
120

191  
120

710  
600  
110

116  
107  
9 Chms inserted

Feb. 15, 1881.  
Order 192-R205  
100 1/2 V-25

1161015480

18840  
21000

200/20940/104  
200

940  
800  
140

105  
130  
3150

105  
116/13650/117  
116

205  
116  
890  
812  
78

118  
105  
13 Chms inserted.

Feb. 15, 1881.  
Order 192-R195  
100 U-27

114.75 U 48c

18840  
1000

200/18940/94

940

800

140

95

130

2850

95

115/12350/107

115

850

805

45

107

96

11

Chms inserted.

Feb. 15, 1881.  
Order 192-R355  
104 1/2 U-29

121.50 U 48c

18840  
2400

200/21240/106

200

1240

1200

106

130

3180

106

122/13780/112

122

158

122

360

244

116

113

106

7

Chms inserted.

Feb. 15, 1881.  
Order 35-R 265  
108 V-8

1261905 412

18840 P  
7200

200/26040/130  
200  
604  
600  
40

130  
130  
3900  
130  
127/16900/133  
127  
420  
381  
390  
381  
9

133  
130  
3 Chms inserted.

Feb. 15, 1881.  
Order 35-R 360  
114 1/2 V-25

1305, 33C

251270  
3700

200/28827/144  
200  
882  
800

827  
144  
130  
4320  
144  
130/18720/144  
130  
572  
520  
520  
520

Feb. 15, 1881.  
Order 35-R 325  
106 1/2 U-1

124.83548e

18840  
3900

200/22740/113

274  
200

740  
600

114  
130

140

3420

114

125/14820/118

125

232

125

1070

1000

70

119  
114  
5 Chms inserted.

Feb. 15, 1881.  
Order 35-R 235  
108 1/2 U-24

12423048e

18840  
4800

200/23640/118

364  
200

1640

118 1600

130 40

3540

118

124/15340/123

124

294

248

460

372

88

124  
118

6 Chms inserted.

Feb. 15, 1881.  
Order 35-R 315  
102 V-23

1131405 48 R

18840  
4500

200/23340/116

334  
200

1340  
1200

140

117  
130

3510

117  
113

113/15210/134

391  
339

520  
452

68

135  
117  
18 Chms inserted.

Feb. 15, 1881.  
Order 35-R 210  
108 1/2 V-12

121.505 48 R

18840  
5500

200/24340/121

434  
400

340  
200

122  
130

3660

122/15860/130

122  
366

0

130  
122  
8 Chms inserted.



Feb. 15, 1881.

Order 35-R 190

104U-18

122.85 r 48e

$$\begin{array}{r} 18840 \\ 5000 \end{array}$$

$$\begin{array}{r} 200 \overline{) 23840} \\ 200 \end{array}$$

$$\begin{array}{r} 384 \\ 200 \\ \hline 1840 \\ 1800 \end{array}$$

119

130

3570

119

$$123 \overline{) 15470} \quad 125$$

123

317

246

710

615

95

126

119

7 Chms inserted.

Feb. 15, 1881.

Order 35-R 335

High - 20

120 r 26C

$$\begin{array}{r} 18840 \\ 7000 \end{array}$$

$$\begin{array}{r} 200 \overline{) 25840} \\ 200 \end{array}$$

$$\begin{array}{r} 584 \\ 400 \\ \hline 1840 \\ 1800 \end{array}$$

129

130

3870

129

$$130 \overline{) 16770} \quad 129$$

130

377

260

1170

1170

Feb. 15, 1881.  
Order 35-R315  
105 V-30

122.85 V 48

18840  
3200

200/22040/110  
200  
204  
200  
40

110  
130  
3300  
110  
123/14300/116  
123  
200  
123  
770  
738  
32

116  
110  
6 Chms inserted.

Feb. 15, 1881.  
Order 35-R350  
106 1/2 V-20

126.905 45 e

18840  
5200

200/24040/120  
200  
404  
400  
40

120  
130  
3600  
120  
127/15600/122  
127  
290  
254  
360  
254  
106

123  
120  
3 Chms inserted.

Feb. 18, 1881.

Order 205-

94V-1

+

101.25 V Bulwer's Eagle  
C48

$$\begin{array}{r} 12560 \\ 5000 \\ \hline 200/18360/91 \\ 1800 \end{array}$$

$$\begin{array}{r} 360 \\ 200 \\ \hline 160 \end{array}$$

$$\begin{array}{r} 92 \\ 130 \\ \hline 2760 \\ 92 \end{array}$$

$$\begin{array}{r} 101/11960/118 \\ 101 \end{array}$$

$$\begin{array}{r} 186 \\ 101 \end{array}$$

$$\begin{array}{r} 850 \\ 808 \end{array}$$

$$\begin{array}{r} 42 \end{array}$$

$$\begin{array}{r} 118 \\ 92 \end{array}$$

26 Chms inserted.

Feb. 18, 1881.

Order 205-

104 1/2 V-21

+

120.82 V 4:50

$$\begin{array}{r} 16840 \\ 3200 \end{array}$$

$$\begin{array}{r} 200/22140/110 \\ 200 \\ 214 \\ 200 \\ \hline 140 \end{array}$$

$$\begin{array}{r} 111 \\ 130 \\ \hline 3330 \end{array}$$

$$\begin{array}{r} 111 \\ 121/114430/119 \\ 121 \end{array}$$

$$\begin{array}{r} 233 \\ 121 \end{array}$$

$$\begin{array}{r} 1120 \\ 1089 \end{array}$$

$$\begin{array}{r} 31 \end{array}$$

$$\begin{array}{r} 119 \\ 111 \end{array}$$

8 Chms inserted.

Feb. 18, 1881.  
Order 150-R520  
102 U-4

114.75 48 C

18543

200/22340/111

200  
234  
200  
340  
200  
140

112  
130

3360

112

115/14560/126

115  
306  
230  
760  
690  
70

127  
112

15 Chms inserted.

Feb. 18, 1881.  
Order 150-R480  
104 1/2 U-10

118.125 48 C

18843

200/20940/104

200  
940  
800  
140

105  
130  
3150

105

118/13650/115

118  
185  
118  
670  
590  
80

116  
105

11 Chms inserted.

226

Feb. 18, 1881.  
Order 150-R500  
11105-27

118.125 480

18840  
2500

200/21340/106  
200  
1340  
1200  
140

107  
130  
3210  
107

118/13910/117

211  
118  
930  
826  
104

118  
107  
11 Chms inserted.

227

Feb. 18, 1881.  
Order 205-  
9405-19 B +

104.625 48

12560  
7400

200/19960/99  
1800  
1960  
1800  
160

100  
130  
105/13000/123

250  
210  
400  
315  
85

124  
100  
24 Chms inserted

Feb. 18, 1881.  
Order 205-91 1/2 U  
7 +

106.65 U 48 C

12560  
7100 R

200/1966 0/98  
1800  
1660  
1600  
60

99  
130  
2970  
99  
120  
99

107/12870/120 21 Chms inserted.

107  
217  
214  
30

Feb. 18, 1881.  
Order 205 +  
95 U-3

~~12560~~

106.65 U 48

12560  
5400 R

200/17960/89  
1600  
1960  
1800  
160

90  
130  
2700  
90  
109  
90

.19 Chms inserted.

107/11700/109  
107  
1000  
963  
37

Feb. 18, 1881.  
Order 205  
97 1/2 U-12<sup>A</sup>

105.88 U 480

12560

6200

200/18860/94  
1800

860  
800

95  
130

2850

95

106/12350/116  
106

175

106

690

636

54

117  
95

22 Chms inserted.

Feb. 18, 1881.  
Order 205-  
95 U-19<sup>A</sup> +

104.62 U 480

12560

6400

200/18960/94  
1800

960  
800

95

130

2850

95

105/12350/117  
105

185

105

800

735

65

118  
95

23 Chms inserted.

Feb. 18, 1881.  
Order 205- +  
96U-25

102.605 48c

12560  
6200

200/18760/93

760  
600  
160

94  
130

2820

94

103/12220/118

192

103

890

824

66

119

94

25 Chms inserted.

Feb. 18, 1881.  
Order 205- +  
96U-13

103.275 48c

12560  
5500

200/18060/90

91

130

2730

91

103/11830/114

153

103

500

412

88

115

91

24 Chms inserted.



Feb. 18, 1881.  
Order 205-  
98U-11

109.250 40 e

12560  
6700 R

200/19260/96  
1800

1260  
1200

97  
130  
2910

116  
97

19 Chms inserted.

109/12610/115  
109

171  
109

620

545

75

Feb. 18, 1881.  
Order 205- +  
97 1/2 U-5

109.355 V

12560  
6000 R

200/18560/92  
1800

560  
400  
160

93  
130  
2790  
93

111  
93

18 Chms inserted.

109/12090/110  
109

119  
109  
100

Feb. 18, 1881.  
Order 205 - +  
98 1/2 V-17

1.09.355V 48C

~~10~~ 12560  
9100 R

200/21660/108  
2100

1660  
1600  
60

109  
130  
3270  
109  
109/14170/130  
109  
327  
327  
0

130  
109

21 Chms inserted.

Feb. 18, 1881.  
Order 202  
107 1/2 V-1

112.72V 48C

12560  
9300 R

200/21860/109  
200

1860  
1800  
60

110  
130  
3300

110

113/14300/126  
113

300  
226

740  
678  
62

127  
110

17 Chms inserted.

Feb. 18, 1881.  
Order 202  
118V-13

118.125 48C

18840  
5900R

200/24740/123  
200

474

400

740

600

124 140

130

3720

124

118/16120/136

118

432

354

780

708

72

137

124

13 Chms inserted.

Feb. 18, 1881.  
Order 202  
105 1/2 V-12<sup>B</sup>

118.125 48C

18840  
3400R

200/22240/111  
200

224

200

240

200

40

111

130

3330

111

118/14430/122

118

263

236

270

236

34

122

111

11 Chms inserted.

Feb. 18, 1881.  
Order 202-114 1/2 V  
12<sup>A</sup>

126.90 V 48 C

18840 R  
4800 R

200/23640/118  
200

364

200

1640

1600

40

118

138

3540

118

127/15340/120

127

264

254

100

128

118

10 Chms inserted.

Feb. 18, 1881.  
Order 202-115 V  
20(B)

124.83 V 48 C

18840 R  
3300 R

200/22140/110  
200

214

200

140

111

130

3330

111

125/14430/115

125

193

125

680

625

55

116

111

5 Chms inserted.

Feb. 18, 1881.  
Order 202-107 1/2 V  
20(A)

118,125 48 C

1840 R  
2900

200/21740/108  
200

1740

1600

140

109

130

3270

109

118/14170/120

118

237

236

10

120

109

11 Chms inserted

Feb. 18, 1881.  
Order 202-105 1/2 V  
30.

118,125 48 C

1840 R  
2500

200/21340/106  
200

1340

1200

106

130

140

3180

106

118/13780/116

118

198

118

800

708

920

117

107

10 Chms inserted

Feb. 18, 1881.  
Order 202-106 1/2 ✓  
3

$$\begin{array}{r}
 120.15 \sqrt{48} C \\
 18840 \\
 \underline{2300} \\
 200 \overline{) 21140} / 105 \\
 \underline{200} \\
 1140 \\
 \underline{1000} \\
 140
 \end{array}$$

$$\begin{array}{r}
 106 \\
 \underline{130} \\
 3180 \\
 106 \\
 120 \overline{) 13780} / 114 \\
 \underline{120} \\
 178 \\
 \underline{120} \\
 580 \\
 \underline{480} \\
 100
 \end{array}$$

115  
106  
9 Chms inserted.

Feb. 18, 1881.  
Order 202-111 1/2 ✓  
11

$$\begin{array}{r}
 126.22 \sqrt{48} C \\
 18840 \\
 \underline{3300} \\
 200 \overline{) 22140} / 110 \\
 \underline{200} \\
 214 \\
 \underline{200} \\
 140
 \end{array}$$

$$\begin{array}{r}
 111 \\
 \underline{130} \\
 3330 \\
 111 \\
 126 \overline{) 14430} / 114 \\
 \underline{126} \\
 183 \\
 \underline{126} \\
 570 \\
 \underline{504} \\
 66
 \end{array}$$

115  
111  
4 Chms inserted.

Feb. 18, 1881.  
Order 202-108 ✓  
18(B)

121.50. ✓ 48c

$$\begin{array}{r} 18840 \\ 1300 \overline{) 18840} \\ \underline{200} 20140 / 100 \\ \underline{200} \\ 140 \end{array}$$

$$\begin{array}{r} 101 \\ 130 \\ 3030 \\ 101 \overline{) 13130} / 107 \\ \underline{122} \\ 930 \\ 854 \\ \underline{76} \end{array}$$

108  
101  
7 Chms inserted

Feb. 18, 1881.  
Order 202-109 ✓  
18(A)

118.12 ✓ 48c

$$\begin{array}{r} 18840 \\ 1400 \overline{) 18840} \\ \underline{200} 20240 \\ \underline{101} 10140 \\ \underline{200} \end{array}$$

$$\begin{array}{r} 101 \\ 130 \\ 3030 \\ 101 \overline{) 13130} / 111 \\ \underline{118} \\ 133 \\ 118 \\ \underline{150} \\ 118 \\ \underline{32} \end{array}$$

111  
101  
10 Chms inserted.

Feb. 18, 1881.  
Order 202-109 U  
2 (B)

124.8315 48 e

$$\begin{array}{r} 18840 \\ 5200 \\ \hline 200 \overline{) 24040} \\ \underline{120} \phantom{00} 40 \\ 200 \end{array}$$

$$\begin{array}{r} 120 \\ 130 \\ \hline 3600 \\ 120 \\ \hline 125 \overline{) 15600} / 124 \\ \underline{125} \\ 310 \\ 250 \\ \hline 600 \\ 500 \\ \hline 100 \end{array}$$

125  
120  
5 @ms inserted.

Feb. 18, 1881.  
Order 202-109 U  
2 (A)

121.505 48 e

$$\begin{array}{r} 18840 \\ 3200 \\ \hline 200 \overline{) 22040} / 110 \\ \underline{200} \\ 204 \\ 200 \\ \hline 40 \end{array}$$

$$\begin{array}{r} 110 \\ 130 \\ \hline 3300 \\ 110 \\ \hline 122 \overline{) 14300} / 117 \\ \underline{122} \\ 210 \\ 122 \\ \hline 880 \\ 854 \\ \hline 26 \end{array}$$

117  
110  
7 @ms inserted.



Feb. 18, 1881.  
Order 202-11105  
7(A)

124.835 48e

$$\begin{array}{r} 18840 \\ 3400 \\ \hline 200 \overline{) 22240} \\ \underline{111} \phantom{00} \\ 111 \phantom{00} \\ \underline{111} \phantom{00} \\ 0 \end{array}$$

$$\begin{array}{r} 111 \\ 130 \\ \hline 3330 \\ 111 \\ \hline 125 \overline{) 14430} / 115 \\ \underline{125} \phantom{00} \\ 193 \phantom{00} \\ \underline{125} \phantom{00} \\ 680 \phantom{00} \\ \underline{625} \phantom{00} \\ 55 \end{array}$$

116  
111  
5 Chms inserted.

Feb. 18, 1881.  
Order 202-10612  
7(B)

111.345 48e

$$\begin{array}{r} 18840 \\ 1600 \\ \hline 200 \overline{) 20440} \\ \underline{102} \phantom{00} \\ 102 \phantom{00} \\ \underline{102} \phantom{00} \\ 0 \end{array}$$

$$\begin{array}{r} 102 \\ 130 \\ \hline 3060 \\ 102 \\ \hline 111 \overline{) 13260} / 119 \\ \underline{111} \phantom{00} \\ 216 \phantom{00} \\ \underline{111} \phantom{00} \\ 1050 \phantom{00} \\ \underline{999} \phantom{00} \\ 51 \end{array}$$

120  
102  
18 Chms inserted.

Feb. 18, 1881.  
Order 202-106 1/2 V  
17

$$\begin{array}{r} 111.345 \ 48 \ C \\ 18840 \ R \\ 400 \\ \hline 200/22840 \\ 114 \ 40 \\ \hline 200 \end{array}$$

$$\begin{array}{r} 114 \\ 130 \\ \hline 3420 \\ 114 \\ \hline 111/14820/133 \\ 111 \end{array}$$

$$\begin{array}{r} 372 \\ 333 \\ \hline 390 \\ 333 \\ \hline 57 \end{array}$$

$$\begin{array}{r} 134 \\ 111 \\ \hline 23 \text{ Chms inserted.} \end{array}$$

Feb. 18, 1881.  
Order 202-104 1/2 V  
5

$$\begin{array}{r} 118.125 \ 48 \ C \\ 18840 \ R \\ 3000 \\ \hline 200/21840 \\ 109 \ 40 \\ \hline 200 \end{array}$$

$$\begin{array}{r} 109 \\ 130 \\ \hline 3270 \\ 109 \\ \hline 118/14170/120 \\ 118 \end{array}$$

$$\begin{array}{r} 237 \\ 236 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 120 \\ 109 \\ \hline 11 \text{ Chms inserted.} \end{array}$$

116 120 1109 -

Feb. 18, 1881.  
Order 202-102 1/2 U  
24(B)

114.075 48 e

$$\begin{array}{r} 18840 \\ - 9000 \\ \hline 200 \overline{) 19740} \\ \underline{98140} \\ 200 \end{array}$$

$$\begin{array}{r} 99 \\ 130 \\ \hline 29.70 \\ 99 \\ \hline 114 \overline{) 12870} \end{array}$$

$$\begin{array}{r} 114 \\ 147 \\ \hline 114 \\ \hline 330 \\ 228 \\ \hline 102 \end{array}$$

113  
99  
14 Chms inserted.

Feb. 18, 1881.  
Order 202-107 1/2 U  
24 A

120.155 48 e

$$\begin{array}{r} 15840 \\ 2200 \\ \hline 200 \overline{) 21040} \\ \underline{105140} \\ 200 \end{array}$$

$$\begin{array}{r} 105 \\ 130 \\ \hline 3150 \\ 105 \\ \hline 120 \overline{) 13650} \end{array}$$

$$\begin{array}{r} 165 \\ 120 \\ \hline 450 \\ 360 \\ \hline 90 \end{array}$$

114  
105  
9 Chms inserted.

256

Feb. 18, 1881.  
Order 202-118 1/2 V  
6 D

124183 V 48 C

$$\begin{array}{r} 18840 \\ 4200 \\ \hline 200 \overline{) 23040} \\ 115 \overline{) 40} \\ 200 \end{array}$$

$$\begin{array}{r} 115 \\ 130 \\ \hline 3450 \\ 115 \\ \hline 120 \overline{) 114950} / 119 \\ 125 \end{array}$$

$$\begin{array}{r} 245 \\ 125 \\ \hline 1200 \\ 1125 \\ \hline 75 \end{array} \quad \begin{array}{r} 120 \\ 115 \\ \hline 5 \text{ Chms inserted} \end{array}$$

257

Feb. 18, 1881.  
Order 202-107 V  
6 (C)

119.47 V 48 C

$$\begin{array}{r} 18840 \\ 3000 \\ \hline 200 \overline{) 21840} \\ 109 \overline{) 40} \\ 200 \end{array}$$

$$\begin{array}{r} 109 \\ 130 \\ \hline 3270 \\ 109 \\ \hline 119 \overline{) 14170} / 119 \\ 119 \end{array}$$

$$\begin{array}{r} 227 \\ 119 \\ \hline 1080 \\ 1071 \\ \hline 9 \end{array} \quad \begin{array}{r} 119 \\ 109 \\ \hline 10 \text{ Chms inserted} \end{array}$$

Feb. 18, 1881.  
Order 202-102V  
6(B)

$$\begin{array}{r} 118.125 \text{ H8C} \\ 18840 \\ \hline 4200 \text{ R} \\ 200 \overline{) 23040} \\ \underline{115} \quad 40 \\ 200 \end{array}$$

$$\begin{array}{r} 115 \\ \underline{130} \\ 3450 \\ \underline{115} \\ 118 \overline{) 14950} / 126 \\ \underline{118} \\ 315 \\ \underline{236} \\ 790 \\ \underline{708} \\ 82 \end{array}$$

$$\begin{array}{r} 127 \\ \underline{115} \\ 12 \text{ Chms inserted.} \end{array}$$

Feb. 18, 1881.  
Order 202-110V  
6(A)

$$\begin{array}{r} 121.505 \text{ H8C} \\ 18840 \\ \hline 3750 \text{ R} \\ 200 \overline{) 22540} \\ \underline{112} \quad 140 \\ 200 \end{array}$$

$$\begin{array}{r} 113 \\ \underline{130} \\ 3390 \\ \underline{113} \\ 122 \overline{) 14690} / 120 \\ \underline{122} \\ 249 \\ \underline{244} \\ 50 \end{array}$$

$$\begin{array}{r} 121 \\ \underline{112} \\ 9 \text{ Chms inserted.} \end{array}$$

Feb. 18, 1881.  
Order 202-110 V  
29

121.50 V 48 C

18840  
2200 R

200/21040  
105 40  
200

105  
130  
3150  
105  
122/13650/111  
122  
145  
122  
230  
122  
108

112  
105  
7 Chms inserted.

Feb. 18, 1881.  
Order 202-111 V  
30

121.50 V 48 C

18844  
2700 R

200/21544  
102 144  
200

102  
130  
3060  
102  
122/13260/108  
122  
1060  
976  
84

109  
103  
6 Chms inserted.

Feb. 18, 1881.  
Order 202-120V  
27

130V 48C

18840  
5000

200/23840  
11940  
200

119  
130  
3570  
119  
-130/25470/119  
130  
247  
130  
1170  
1170

Feb. 18, 1881.  
Order 202-119V  
22A

No vac. went up

Feb. 18, 1881.  
Order 202-106 V  
9(B)

116.105 48 C

18840  
700 R

200  $\overline{) 19540}$   
97  $\overline{) 140}$   
200

98  
130  
2940  
98  
116  $\overline{) 12740 / 109}$   
116

1140  
1044  
96

110  
98  
12 Chms inserted.

Feb. 18, 1881.  
Order 202-107 1/2 V  
9(A)

120.155 48 C

18840  
1800 R

200  $\overline{) 20640}$   
103  $\overline{) 40}$   
200

103  
130  
3090  
103  
120  $\overline{) 13390 / 111}$   
120

139  
120  
190  
120  
70.

112  
103  
9 Chms inserted.



Feb. 18, 1881.  
Order 202-111 V  
14B

126.90 V 48 R

18840  
3200

200 22040

110 R

130  
3300

110  
127/14300/112

127  
160  
127  
330  
254  
76

113  
110  
3 Chms inserted

Feb. 18, 1881.  
Order 202-106/2 V  
14A

121.50 V 48 R

18840  
1200

200/20040  
100 40  
200

100  
130  
3000  
100  
127/13000/106  
122

800 107  
732 100  
68 7 Chms inserted.

Feb. 18, 1881.  
Order 202-107 1/2 V  
23 B

120.82 V 48 C

$$\begin{array}{r} 18840 \\ 2800 \\ \hline 200 \overline{) 21640} \\ \underline{108} \quad 140 \\ 200 \end{array}$$

$$\begin{array}{r} 108 \\ 130 \\ \hline 3240 \\ 108 \\ \hline 121 \overline{) 14040} / 116 \\ \underline{121} \\ 194 \\ \underline{121} \\ 730 \\ \underline{726} \\ 4 \end{array}$$

116  
108  
8 Chms inserted.

Feb. 18, 1881.  
Order 202-114 1/2 V  
23 A

127.57 V 48 C

$$\begin{array}{r} 18840 \\ 4800 \\ \hline 200 \overline{) 23140} \\ \underline{115} \quad 140 \\ 200 \end{array}$$

$$\begin{array}{r} 116 \\ 130 \\ \hline 3480 \\ 116 \\ \hline 128 \overline{) 15080} / 117 \\ \underline{128} \\ 228 \\ \underline{128} \\ 1000 \\ \underline{896} \\ 104 \end{array}$$

118  
116  
2 Chms inserted.

Feb. 18, 1881.  
Order 202-110 V  
26

$$\begin{array}{r} 121.500 \quad 48c \\ 18840 \\ 2600R \\ \hline 200 \overline{) 21440} \\ \underline{107} \quad 40 \\ 107 \quad 200 \end{array}$$

$$\begin{array}{r} 107 \\ 130 \\ \hline 3210 \\ 107 \\ \hline 122 \overline{) 13910} / 114 \\ \underline{122} \end{array}$$

$$\begin{array}{r} 171 \\ 122 \\ \hline 490 \\ 488 \\ \hline 2 \end{array} \quad \begin{array}{r} 114 \\ 107 \\ \hline 7 \text{ Chms inserted.} \end{array}$$

Feb. 18, 1881.  
Order 202-114 V  
10 B

$$\begin{array}{r} 124.200 \quad 45c \\ 18840R \\ \hline 200 \overline{) 23740} \\ \underline{118} \quad 140 \\ 118 \quad 200 \end{array}$$

$$\begin{array}{r} 119 \\ 130 \\ \hline 3570 \\ 119 \\ \hline 124 \overline{) 15470} / 124 \\ \underline{124} \end{array}$$

$$\begin{array}{r} 307 \\ 248 \\ \hline 590 \\ 496 \\ \hline 94 \end{array}$$

$$\begin{array}{r} 125 \\ 119 \\ \hline 6 \text{ Chms inserted.} \end{array}$$

Feb. 18, 1881.  
Order 202-107V  
10A

118.80V 45E

$$\begin{array}{r} 200 \overline{) 11880} R \\ \underline{94} \phantom{00} \\ 2480 \end{array}$$

$$\begin{array}{r} 94 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 2820 \\ \underline{94} \end{array}$$

$$\begin{array}{r} 119 \overline{) 12220} / 102 \\ \underline{119} \phantom{00} \end{array}$$

$$\begin{array}{r} 320 \\ \underline{238} \end{array}$$

$$\begin{array}{r} 82 \end{array}$$

$$\begin{array}{r} 103 \\ \underline{94} \end{array}$$

$$\begin{array}{r} 9 \end{array}$$

Chms inserted.

Feb. 18, 1881.  
Order 202-107V  
15(B)

119.47V 48E

$$\begin{array}{r} 18540 \\ \underline{1200} R \end{array}$$

$$\begin{array}{r} 200 \overline{) 20040} \\ \underline{100} \phantom{00} \\ 10040 \end{array}$$

$$\begin{array}{r} 100 \\ \underline{130} \end{array}$$

$$\begin{array}{r} 119 \overline{) 13000} / 109 \\ \underline{119} \phantom{00} \end{array}$$

$$\begin{array}{r} 1100 \\ \underline{1071} \end{array}$$

$$\begin{array}{r} 29 \end{array}$$

$$\begin{array}{r} 109 \\ \underline{100} \end{array}$$

$$\begin{array}{r} 9 \end{array}$$

Chms inserted.

Feb. 18, 1881.  
Order 202-92 V  
15A

104.62 V. 48C

12560  
6000

200/18560  
92 160  
200

93  
130  
2790  
93  
105/12090/115  
105  
159  
105  
540  
525  
15

115  
93  
22 Chms inserted.

Feb. 18, 1881.  
Order 202-103 V  
4B

114.75 V 48C

12560  
5300

200/17860  
89 60  
200

90  
130  
115/11200/101  
115  
200  
115  
85

102  
90  
12 Chms inserted.

Feb. 18, 1881.  
Order 202-99 1/2 V  
4A

114.07 V 48 C

~~188~~

12560 R  
8100

200/20660  
103 60  
200

104  
130

3120

104

114/13520/118.

114

210

114

960

912

48

118

104

14 Chms inserted.

Feb. 18, 1881.  
Order 202-103 V  
28

112.05 V 48 C

12560  
8400

200/20960  
104 160  
200

105

130

3150

105

112/13650/121

112

245

224

210

112

98

122

105

17 Chms inserted.

Feb. 18, 1881.  
Order 202-106V  
25

113.40V 48c

9000P  
12560

$$\begin{array}{r} 200 \overline{) 21560} \\ \underline{107} \quad 160 \\ 200 \end{array}$$

$$\begin{array}{r} 108 \\ 130 \\ \underline{3240} \\ 108 \end{array}$$

$$113 \overline{) 14040} / 124$$

$$\begin{array}{r} 274 \\ \underline{226} \end{array}$$

$$\begin{array}{r} 480 \\ \underline{452} \end{array}$$

$$28$$

$$\begin{array}{r} 124 \\ \underline{108} \end{array}$$

16 Chms inserted.

Feb. 18, 1881.  
Order 202-107 1/2V  
22 1/2

113.40V 48c

9000P  
12560

$$\begin{array}{r} 200 \overline{) 21560} \\ \underline{107} \quad 160 \\ 200 \end{array}$$

$$\begin{array}{r} 108 \\ 130 \\ \underline{3240} \\ 108 \end{array}$$

$$113 \overline{) 14040} / 124$$

$$\begin{array}{r} 274 \\ \underline{226} \end{array}$$

$$\begin{array}{r} 480 \\ \underline{452} \end{array}$$

$$28$$

$$\begin{array}{r} 124 \\ \underline{108} \end{array}$$

16 Chms inserted.

Feb. 18, 1881.  
Order 202-107 V  
16 (B)

114175 V. @48

12560  
8000 R

$$\begin{array}{r} 200 \overline{) 20560} \\ 102 \underline{160} \\ 200 \end{array}$$

$$\begin{array}{r} 103 \\ 130 \\ \hline 3090 \end{array}$$

$$\begin{array}{r} 103 \\ 115 \overline{) 13390} \\ 115 \underline{189} \\ 115 \underline{740} \\ 690 \\ 50 \end{array}$$

117  
103  
14 Chms inserted.





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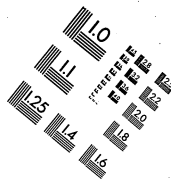
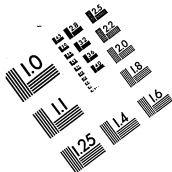
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